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AND

MAGAZINE OF NATURAL HISTORY,

INCLUDING

ZOOLOGY, BOTANY, AND GEOLOGY.

(BEING A CONTINUATION OF THE 'ANNALS' COMBINED WITH LOUDON AND CHARLESWORTH'S 'MAGAZINE OF NATURAL HISTORY.')

CONDUCTED BY

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"Omnes res creatæ sunt divinæ sapientiæ et potentiæ testes, divitiæ felicitatis humanæ:—ex harum usu *bonitas* Creatoris; ex pulchritudine *sapientia* Domini; ex œconomiâ in conservatione, proportione, renovatione, *potentia* majestatis elucet. Earum itaque indagatio ab hominibus sibi relictis semper æstimata; à verè eruditis et sapientibus semper exculta; malè doctis et barbaris semper inimica fuit."—LINNÆUS.

"Quel que soit le principe de la vie animale, il ne faut qu'ouvrir les yeux pour voir qu'elle est le chef-d'œuvre de la Toute-puissance, et le but auquel se rapportent toutes ses opérations."—BRUCKNER, *Théorie du Système Animal*, Leyden, 1767.

. . . . The sylvan powers
Obey our summons; from their deepest dells
The Dryads come, and throw their garlands wild
And odorous branches at our feet; the Nymphs
That press with nimble step the mountain-thyme
And purple heath-flower come not empty-handed,
But scatter round ten thousand forms minute
Of velvet moss or lichen, torn from rock
Or rifted oak or cavern deep: the Naiads too
Quit their loved native stream, from whose smooth face
They crop the lily, and each sedge and rush
That drinks the rippling tide: the frozen poles,
Where peril waits the bold adventurer's tread,
The burning sands of Borneo and Cayenne,
All, all to us unlock their secret stores
And pay their cheerful tribute.

J. TAYLOR, *Norwich*, 1818.

ALERE FLAMMAM.

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THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

"................ per litora spargite muscum,
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hìc carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas;
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasii Ecl. 1.

No. 43. JULY 1891.

I.—*The Devonian Fish-Fauna of Spitzbergen.* By A. SMITH WOODWARD, F.L.S., F.G.S., of the British Museum (Natural History).

[Plates I.–III.]

DURING a visit to the Royal State Museum at Stockholm two years ago the writer had the privilege of examining the collection of Devonian fish-remains from Spitzbergen obtained by the Swedish expeditions to that country under the direction of Baron Nordenskjöld and Dr. A. G. Nathorst. A selected series of the specimens had already been submitted to Prof. Ray Lankester, who published figures and brief notes upon several of the more striking remains in 1884*; but, from a detailed review of the whole collection, it soon became evident that the materials were worthy of more extended study, and Prof. Gustav Lindström kindly undertook to forward them to the British Museum, where comparisons with known types could be most readily instituted. The opportunity for such comparisons has now been afforded, and palæichthyologists are much indebted to Prof. Lindström for thus rendering possible the discovery of a number of new facts, which it is the object of the following notes to record.

* E. Ray Lankester, "Report on Fragments of Fossil Fishes from the Palæozoic Strata of Spitzbergen," Kongl. Svenska Vetensk.-Akad. Handl. vol. xx. no. 9 (1884).

As already remarked by Prof. Lankester, the fish-remains extend the conclusions of the Swedish geologists*, and prove that two distinct horizons—an Upper and a Lower—are recognizable in the Devonian formation of Spitzbergen. Some of the rocks of the lower division are indistinguishable from certain red sandstones, grey micaceous sandstones, and cornstones occurring in the Lower Old Red Sandstone series of the west of England. The fish-bearing horizon of the upper division is a compact and dark-coloured clayey ironstone.

I. Fish-Fauna of the Lower Devonian.

Subclass **OSTRACODERMI.**

Order HETEROSTRACI.

Family **Pteraspidæ.**

Genus Pteraspis.

Being known only by ventral shields and fragments, the generic determination of the Pteraspidians from Spitzbergen is only provisional. Most probably, however, the remains are referable to the type genus, *Pteraspis.*

Pteraspis Nathorsti (Lankester). (Pl. II. fig. 1.)

1884. *Scaphaspis Nathorsti*, E. R. Lankester, Kongl. Svenska Vetensk.-Akad. Handl. vol. xx. no. 9, p. 5, pl. i. figs. 1–3.

As remarked by Lankester, the ventral shield of this species seems to have been slightly broader and shorter than the typical form met with in the Herefordshire cornstones, and it is readily distinguished from all known species by the feeble beading and crimping of the surface-ridges. As shown by one specimen (Pl. II. fig. 1), the obtusely rounded median extension of the posterior end of the shield is also characteristic. On the visceral aspect the hinder border seems to exhibit a faint thickening, and there is a feebly marked median tubercle immediately in advance.

Form. and Loc. Red Micaceous Sandstone and Cornstones, Dickson Bay; Grey Tilestone, Klaas Billen Bay.

Pteraspis, sp. ind.

Some specimens of the red sandstone from Liefde Bay are

* A. E. Nordenskiöld, "Sketch of the Geology of Ice Sound and Bell Sound, Spitzbergen," Geol. Mag. [2] vol. iii. (1876), pp. 16–23.

filled with fragments of Pteraspidian shields too imperfect for specific determination. So far as the writer has observed, the superficial ridged ornament upon these fossils does not exhibit any crimping, being quite smooth and as even as in the typical species.

Order OSTEOSTRACI.

Family **Cephalaspidæ.**

A further examination of the supposed evidence of *Cephalaspis* from the Lower Devonian of Spitzbergen (Lankester, *op. cit.* p. 5, pl. i. fig. 4, pl. ii. fig. 5) suggests doubts as to the determination of the larger fossil, and proves that the smaller specimen represents a new species of *Acanthaspis* (see p. 4). It is quite possible that the former may be truly referable to the same category as the triangular spines of *Psammosteus* and *Oracanthus*; but more satisfactory specimens are required for the study of the histology of the fossil.

Order ANTIARCHA.

Family **Acanthaspidæ.**

Exoskeleton robust, ornamented with tuberculations of ganoine; dorsal and ventral shields of trunk firmly united by the lateral plates, the dorsal comparatively simple, the ventral as in Asterolepidæ. [Head unknown.] A pair of fixed, spine-like, lateral appendages in the pectoral region, encased in a thick plate or plates. [Caudal region unknown.]

The recognition of this family seems to be now rendered possible by the discovery of the specimen described below as *Acanthaspis decipiens.*

Genus Acanthaspis.

Head and trunk broad, not much elevated, and the superficial tuberculations distinct, often arranged in regular concentric series. Anterior dorsal armour apparently consisting of a single broad plate, meeting the ventral armour laterally, and in conjunction with this giving rise to a pair of lateral unciform processes, each bearing a simple, backwardly curved, hollow spine-like appendage.

Of this imperfectly definable genus only a single species (*A. armata* *) has hitherto been met with in the Corniferous

* J. S. Newberry, Rep. Geol. Surv. Ohio, vol. ii. pt. ii. (1875), p. 37, pl. lv. figs. 1–6.

Limestone (Lower Devonian) of Ohio. The type specimens comprise a series of detached plates, now in the museum of Columbia College, New York, some of these exhibiting the lateral appendages which suggested to Dr. Newberry the generic and specific name. In the original description the appendages were compared with the cornua of typical Cephalaspidian fishes, and the new genus was thus supposed to pertain to the latter group, differing from all known forms in having a cephalic shield composed of several distinct plates. If, however, the Spitzbergen fossils prove to be correctly interpreted below, *Acanthaspis* is most nearly related to the Asterolepidæ, and its spine-like processes are the homologues of the well-known pectoral paddles of the latter.

Acanthaspis decipiens, sp. n. (Pl. I.)

1884. *Cephalaspis* (cf. *C. Agassizii*), E. R. Lankester, *op. cit.* p. 5, pl. i. fig. 4.

Pectoral appendages comparatively broad and very gently arched, ornamented in the proximal two thirds by closely arranged longitudinal series of fine tuberculations. Median ventral plate relatively large, about as broad as long, occupying more than half the width of the ventral shield at its middle point. Tubercular ornament very fine and closely arranged.

This species is based upon a small slab of red sandstone exhibiting remains of dermal armour that are at first sight somewhat difficult of interpretation. Before the investing matrix was completely removed, one portion of the fossil was briefly noticed and figured by Lankester (*loc. cit.*) as indicating the occurrence of a species of *Cephalaspis* related to the British *C. Agassizii*; but it is now evident that the organism in question is quite distinct from any hitherto satisfactorily determined and cannot be referred even to the family to which *Cephalaspis* belongs.

As shown in the drawing of the natural size the fossil exhibits two distinct portions of armour, each provided on one side with a large, curved, spinous process. As remarked by Lankester, the two spines appear to be essentially identical, and hence it is reasonable to infer that both parts of the fossil pertain at least to the same species, if not to the same individual. The one shield (A) is distinctly convex on the external aspect, for the exposed concave face of the specimen is smooth and has the characteristic appearance of the visceral aspect. The other shield (B) is chiefly shown as an impression; but it is proved to be nearly flat, and some fragments of the

original tissue exhibit an external ornament of fine tuberculations. The first shield, indeed, may be regarded without hesitation as having enveloped the dorsal aspect of a chordate animal, while the second shield can be determined with equal certainty as originally ventral in position.

The dorsal shield is unfortunately much less nearly complete than the ventral, and, so far as preserved, seems to consist of a single continuous piece. As shown by the fractured margin the substance of the shield comprises a thin outer and inner layer, very dense, separated by a thick layer of cancellæ with delicate septa. The section also proves that there was a thickening of the middle layer, producing on the surface a sharp longitudinal keel in the middle of the back (Pl. I. fig. 2). The posterior portion of the shield is obviously broken away, and if any part of its anterior border remains this is confined to the bilaterally symmetrical reentering angle, from which there proceeds backwards on the visceral aspect a feebly marked ridge, and in relation to which a great pair of processes (*x*) with two pairs of linear impressions are symmetrically disposed. While the downwardly turned border on the right side is well shown, a considerable portion of the left side is thus proved to be missing, and the amount is indicated by the dotted line in fig. 2. The anteriorly and downwardly directed processes (*x*) are unlike any structure hitherto observed by the present writer in an Ostracoderm dorsal shield; they are bluntly rounded, but apparently not much thickened, and are most suggestive of an arrangement for complex articulation with a shield originally occurring in front. The outer of the two divergent lines extending backwards from the base of each process (*m*) corresponds with a sharp longitudinal angulation of the shield, as indicated by the transverse section (fig. 2); and this may perhaps represent an obliterated suture, though the evidence is not conclusive. This line is directed outwards, but the inner line, which has more the appearance of a fold than an indentation, trends gradually towards its fellow of the opposite side behind.

The ventral shield is imperfect on all sides except the right, but in general contour it seems to have closely resembled the corresponding armour of the typical *Pterichthys Milleri* from the Old Red Sandstone of northern Scotland. It is, indeed, broadly ovate, tapering behind. The sutures between the component plates are indicated partly by impressions upon the matrix and partly by the arrangement of the fibres in the fragments of the exoskeletal tissue that remain. There are also some traces of the superficial tubercular ornament, fine towards the middle of the shield, somewhat coarser on the

upturned edge of the lateral plates. The median ventral plate (*m.v.*) is remarkably large, almost equilateral, and about as broad as long, and each ventro-lateral plate is distinctly shown to be continued into an upturned lamina at its outer border. The posterior ventro-lateral plate is comparatively long and narrow, with a broad transverse thickening on its visceral aspect, corresponding to the ridge that seems to mark the hinder boundary of the abdominal cavity in the Asterolepidæ. The anterior ventro-lateral plate is broader in proportion to its length, but the precise form cannot be ascertained on account of the loss of the front margin.

The two shields thus described correspond so closely in size that they might have formed the dorsal and ventral armour of one and the same individual. That they pertain to two distinct specimens, however, seems to be proved by the circumstance that the appendage preserved in each case is on the right side, while its superior surface is more or less intact in both. The appendage is hollow and thin-walled, at least at its base, as indicated by the transverse sections (Pl. I. figs. 3 *a*, *b*), and the broad basal portion is directly continuous both with the dorsal armour of the trunk above and with the anterior ventro-lateral plate below, there being no interposed suture or movable joint. The dorsal and ventral faces of the appendage are evidently flattened and even, while the lateral borders are sharply rounded; and where the surface or its impression is distinctly preserved, close parallel series of small tuberculations are shown to be arranged longitudinally. The greater portion of the spine-like plate consists of fibrous tissue, of which the fibres are longitudinal in direction; but a fortunate plane of fracture in the appendage attached to the dorsal shield exhibits a sharp line of demarcation between the inner border of the proximal half of this element (*s*) and a broad, triangular, basal area (*b*) in which the structural fibres radiate outwards. It is thus evident that the arrangement agrees precisely with that already noted by Newberry in some of the type specimens of *Acanthaspis* from the Corniferous Limestone, where the suture now indicated by minute structural characters is sometimes open, though quite as often closed.

Form. and Loc. Red Micaceous Sandstone, Dickson Bay.

Acanthaspis minor, sp. n. (Pl. II. figs. 2–5.)

A comparatively small species. Appendages slender, gently arcuated, ornamented with few, conspicuous, rounded longitudinal ribs, which are nodose at distant intervals; prominent lateral denticles at least on the concave border.

Plates of trunk ornamented with numerous fine tubercles, of which the majority are arranged in concentric series.

A second species of *Acanthaspis* from the Lower Devonian of Spitzbergen is indicated by the small slab of remains, partly shown in Pl. II. figs. 2–5. In addition to several portions of the characteristically ornamented plates, the fossil exhibits parts of two or perhaps three lateral appendages. There are also two other plates exposed from the inner aspect, the one having the appearance of the occipital region of the cranial shield, while the other is irregularly quadrate and not readily determinable.

The best-preserved fragment of a lateral appendage is enlarged twice in Pl. II. fig. 3, and displays portions of the sparsely nodose, rounded, longitudinal ridges, with some of the stout, backwardly pointing tubercles on the inner or concave border. Another fragment shows that the plate (either dorsal or ventral) at the base of the appendage is tuberculated like the remainder of the armour and exhibits no arrangement of ridges.

The supposed occipital plate (Pl. II. fig. 2) is thus determined because it is bounded on one side by an attenuated border gently excavated in a symmetrical manner with respect to a short broad process (*p*), which is very suggestive of the median process of the occipital shield in the Asterolepidæ. If the element pertains to the same individual as either of the appendages, it is remarkably large; but it may be equivalent to the median occipital and lateral occipitals of the Asterolepidæ fused together, and the plates in the fossil under discussion may represent several individuals.

The small quadrate plate, which is shown of twice the natural size in Pl. II. fig. 5, is worthy of note as being unbroken except at the border directed inferiorly in the drawing. Near the upper end of one of the borders placed vertically there occurs a short truncated process; and at the same extremity of the plate there is a broad triangular depression on the exposed inner face, evidently to be interpreted as a surface of overlap. A vertically elongated mesial excavation also extends from the edge of this facette downwards.

Form. and Loc. Red Micaceous Sandstone, Dickson Bay.

Incertæ sedis.

Genus Lophostracon.

Lophostracon spitzbergense (Lankester).

1884. *Lophostracon spitzbergense*, E. R. Lankester, *op. cit.* p. 5, pl. ii. fig. 6.

The ribbed fragment of dermal armour thus named by Lankester still remains *incertæ sedis*; but two new facts may be added to the original notice. In the first place, when light is allowed to fall upon the impression of the superficial ornament in a certain direction the ridges are distinctly shown to have been crimped or tuberculated. The published figure is thus not quite accurate. Secondly, the tissue of the plate is coarsely cancellated, and numerous irregularly arranged bone-lacunæ can be distinguished in microscopical sections.

It must be remarked, however, that the Spitzbergen *Lophostracon* is not unique. So long ago as 1837 Kutorga * described and figured similar fossils from the Lower Devonian of Livonia, erroneously regarding them as referable to a Chelonian under the name of *Trionyx sulcatus*. Twelve years later, also, Hugh Miller † figured another example from the Old Red Sandstone of Thurso, Caithness, as a "shoulder (*i. e.* coracoid?) plate of *Asterolepis*." All these fossils probably pertain to a large Arthrodiran fish; and they occur upon the same horizon as the genera *Homosteus* and *Heterosteus*.

Form. and Loc. The only known specimen was obtained by Dr. Nathorst from the Red Sandstone of Dickson Bay.

Genus Porolepis, nov.

Syn. *Gyrolepis*, G. Kade (non Agassiz), Programm k. Realschule zu Meseritz, 1858, p. 17.

An imperfectly recognizable genus, known only by detached rhomboidal scales. Scales moderately imbricating, with a feeble inner ridge, and not united by a peg-and-socket articulation; the exposed surface covered with punctate ganoine and in the antero-superior half marked with oblique wrinkles and ridges.

The distinctness of these scales from those of any known genus was first recognized by Kade, who described examples

* S. Kutorga, Beitr. Geogn. u. Paläont. Dorpat's, pt. ii. (1837), p. 13, pl. ii. figs. 1–4.

† H. Miller, 'Footprints of the Creator' (1849), p. 88, fig. 38.

from boulders in Silesia under the preoccupied name of *Gyrolepis*. The punctate character of the ganoine and the absence of a peg-and-socket articulation suggest that the scales pertain to Crossopterygians allied to *Osteolepis* rather than to any Actinopterygian fish.

Porolepis posnaniensis (Kade).
(Pl. II. figs. 6–10.)

1858. *Gyroptychius posnaniensis*, G. Kade, *op. cit.* p. 16, figs. 6, 7.
1858. *Gyrolepis posnaniensis*, G. Kade, *ibid.* p. 18, figs. 8–10.

There are no satisfactory characters by which the scales from Spitzbergen can be specifically distinguished from those discovered by Kade in the boulders of Silesia, and they must thus at present receive the same name. The scales are rectangular or only slightly rhomboidal in shape, and are rarely broader than deep, but often deeper than broad. The hinder margin is not serrated. The superficial wrinkles are acute, prominent, nearly straight, and approximately parallel, with occasional intercalations, but rarely branching; they are usually confined to a narrow space bordering the superior and anterior margins, and never seem to extend beyond the diagonal connecting the postero-superior and antero-inferior angles. The punctations of the ganoine are very numerous and coarse, arranged in single series between the wrinkles, and occasionally displaying an oblique linear arrangement on the unornamented portion of the scale, though more often disposed in an irregular manner upon the last-named area.

Coarsely tuberculated fragments of bone are associated with the scales in the flagstone of Klaas Billen Bay, and may possibly belong to the same fish.

The specimens named *Gyroptychius posnaniensis* by Kade seem to the present writer to be abraded fragments of scales specifically identical with the nearly complete specimens described as *Gyrolepis posnaniensis* by the same author.

Form. and Loc. Grey Micaceous Flagstone, Klaas Billen Bay (very common); Red Micaceous Sandstone, Dickson Bay (rare).

II. Fish-Fauna of the Upper Devonian.

Subclass **ELASMOBRANCHII.**

Ichthyodorulites.

Genus Psammosteus.

Psammosteus arenatus, Agassiz. (Pl. II. fig. 11.)

1845. *Psammosteus arenatus*, L. Agassiz, Poiss. Foss. V. G. R. p. 105, pl. xxxi. figs. 7–10.
1884. "Bony fragment," E. R. Lankester, *op. cit.* p. 6, pl. iv. fig. 17.

This species has hitherto been met with only in the Devonian of North-west Russia and Caithness, and in boulders scattered over the plain of Silesia; but several typical though fragmentary plates occur in the collection from the ironstone of Mimers Valley, and the writer has been able to verify their reference to an Elasmobranch exoskeleton by the examination of microscopical sections. Some of the plates are very stout, measuring as much as 0·006 in maximum thickness; but the tissue seems to be everywhere cancellated beneath the external layer.

Unfortunately none of the specimens completely exhibit their original contour; but some portions of the free borders are recognizable, and one small slab of ironstone seems to show two pairs of nearly flat plates in natural juxtaposition. From the absence of ornament along an area bordering the free margin in several instances it is obvious that the plates either mutually overlapped or were covered at the edges with integument; while the slab just mentioned, if rightly interpreted, indicates that the dermal armature was arranged in a bilaterally symmetrical manner. On the slab in question the inner pair of plates is coarsely ornamented except along the borders of a narrow elongated fontanelle which separates them throughout the greater part of their length mesially; and the remains of the outer pair of plates flanking these indicate that they were much more finely tuberculated. Some of the abraded stellate tubercles are shown, enlarged about four times, in Pl. II. fig. 11 *b*.

In addition to the broad flattened plates there is one specimen of much interest, represented in front view and transverse section in Pl. II. figs. 11, 11 *a*. It is part of a long narrow element, bent at its thickened, mesial, longitudinal line, and ornamented by stellate tuberculations, which are ovate rather than round. The modified form of the tubercles is doubtless due to the shape of the plate, which seems to

have been either a long spine or a problematical elongated element such as has been described by Davis * in *Oracanthus*. There is thus no justification for specifically distinguishing the fossil from the typical plates of *P. arenatus*, with which it is associated.

Form. and Loc. Ironstone, Miners Valley.

Subclass DIPNOI.

Order ARTHRODIRA.

Family (uncertain).

Genus Asteroplax, nov.

Dermal armour robust, superficially ornamented with coarse rounded tubercles, more or less fused into radiating and partly reticulated ridges. Head longer than broad; bones of cranial roof few and large, comprising a median occipital, bounded in front by a pair of trapezoidal plates, which meet in the middle line and occupy the entire width of the shield, these immediately succeeded forwards again by a large diamond-shaped median element and a pair of antero-posteriorly elongated lateral plates; [rostral region unknown].

Though known only by the imperfect fossil described below, the reference of this genus to the Arthrodira seems to be justified by the arrangement of the richly ornamented cranial roof-bones. According to existing definitions, however, it cannot be placed in any known family.

Asteroplax scabra, sp. n. (Pl. III.)

Cranial shield nearly flat posteriorly and the tubercular ornament especially coarse. Breadth of median occipital plate about equal to that of one of the posterior paired plates, and the latter much longer than broad; second median plate nearly as broad as the median occipital.

Notwithstanding the difficulties presented by the interpretation of the type and only known specimen of *A. scabra*, it will probably be admitted without hesitation that the aspect of the fossil shown in Pl. III. fig. 1 exhibits part of a cranial shield with remains of an adjoining cheek-plate (x). It also seems reasonable to assume that the narrower and more finely ornamented portion of the fossil is the base of the rostral region, the broader end the occipital; and the fortunately

* J. W. Davis, Trans. Roy. Dublin Soc. [2] vol. i. p. 529, pl. lxii. fig. 13, pl. lxv. figs. 3, 4.

good preservation of some of the hinder plates reveals the longitudinal median line of the head. The sutures between the cranial elements are well marked; and these are further rendered conspicuous by the predominant fusion of the superficial tubercles into nodose rounded ridges directed at right angles to the borders of the plates, as in certain species of *Bothriolepis*.

Of the median occipital element only part of the anterior margin remains (o). It is acuminate in front, the two halves of the anterior border meeting in an obtuse angle mesially; but the lateral borders of the bone seem to have been parallel. The posterior lateral plates (1) form a symmetrical pair, meeting in a straight longitudinal suture for a short distance mesially, and expanding outwards to occupy the whole of the space between the antero-lateral boundaries of the median occipital, the postero-lateral border of the second median occipital, and the posterior border of the second pair of lateral plates. Judging from the right side of the fossil, each of these bones is broader behind than in front, but its precise postero-lateral extent cannot be determined. A fracture on the left side reveals the impression of a downwardly (and in part outwardly) descending plate from the external border; while an equally fortunate fracture on the right side in advance of the anterior end of the occipital plate exhibits another vertical lamina of bone, almost transverse to the long axis of the skull, but trending somewhat backwards within. These two robust ossifications may perhaps represent the outer and anterior elements of the otic capsules. The second median plate of the cranial roof (o_1) is about as broad as the occipital and seems to have been regularly diamond-shaped, though its left antero-lateral portion is obscured. The second pair of lateral plates is relatively small and represented only by the element of the right side (2). This, however, is completely preserved. It is $2\frac{1}{2}$ times as long as its maximum breadth, and must have been separated from its fellow of the opposite side by a considerable space, which was doubtless occupied by other plates. The outer border of the bone is nearly straight, but the inner border is much arcuated, with a deep broad notch mesially. An adjoining but separate fragment (*z*) seems to have originally occupied this notch; but the great overlapping piece of bone immediately on the left must be considerably displaced, as proved by its size and relatively coarse ornamentation. The outer longitudinal border of the last-mentioned element is broken away, but it is shown to be in direct continuity with a large thick lamina of smooth unornamented bone, which extends throughout its

whole length and forms a plane meeting that of the ornamented plate in an acute angle. The long narrow element extending along the right side of the fossil (x) is exhibited for the most part as an impression of the inner aspect; but sufficient remains to prove that it was comparatively thin except at the border that is now placed innermost, while it tapers in front to an obtusely rounded extremity, on which the superficial ornament is delicate and composed of longitudinally directed nodose ridges. The bone consists of a single nearly flat lamina, and seems to exhibit the characters of a cheek-plate.

Another problematical bone, of very large dimensions, is preserved on the inferior aspect of the fossil, and is shown of two thirds the natural size in Pl. III. fig. 2. In general form it is very suggestive of a clavicular element, and the face exposed to view is marked only by structural fibres radiating from the centre of ossification. At present, however, this element cannot be assigned to a definite place in the skeleton.

Form. and Loc. Ironstone, Mimers Valley.

Subclass **TELEOSTOMI.**

Order CROSSOPTERYGII.

Families **Holoptychiidæ** and **Rhizodontidæ.**

Genera non det.

It is somewhat remarkable that in the collection from the Mimers Valley the Holoptychian fishes should be represented exclusively by teeth, while the Rhizodonts are known only by scales and one imperfect clavicle. A microscopical examination of the teeth has confirmed Lankester's surmise (*op. cit.* p. 6) that they are truly Dendrodont in structure, and they are thus excluded from correlation with the numerous *Strepsodus*-like scales which are well figured in the memoir already quoted. The teeth are not improbably referable to two species of *Holoptychius*, and the scales are very suggestive of those of *Sauripterus*; but until the discovery of more satisfactory specimens it seems unwise to attempt generic and specific determinations.

Family **Onychodontidæ.**

Genus Onychodus.

Onychodus arcticus, A. S. Woodward. (Pl. II. fig. 12.)

1889. *Onychodus arcticus*, A. S. Woodward, Rep. Brit. Assoc. p. 585, and Geol. Mag. [3] vol. vi. p. 499.

The presymphysial bone thus described still remains unique, but an opportunity is now afforded for publishing the drawing of the specimen given in Pl. II. fig. 12. This figure is of twice the natural size, and exhibits the characters already noted in the original description.

Form. and Loc. Ironstone, Mimers Valley.

Incertæ sedis.

In addition to the dermal plates of *Psammosteus* and the bones of Crossopterygian Ganoids the Ironstone of Mimers Valley also furnishes numerous large and robust plates, which appear as yet to be incapable of determination. A few of these are marked with coarse closely arranged tuberculations, which occasionally pass into ridges (Lankester, *op. cit.* pl. iv. fig. 16) ; and their tissue, though not well preserved, seems to have been dense. The majority of the plates, however, are of a different character, exhibiting a relatively thick middle layer of polygonal cancellæ, which is traversed by straight closed canals, sometimes few, sometimes numerous, and now filled with mineral matter. The outer and inner surfaces of these plates, so far as can be observed, are smooth, and the borders always become attenuated, as if adjoining elements were originally united by overlap. Most of the plates are nearly flat, only upturned occasionally at some of the borders; but one specimen is very strongly bent and keeled and thickened along the ridge. Some of the elements were distinctly arranged in symmetrical pairs; and one form of plate is especially suggestive of the ventro-lateral of an Asterolepid fish.

Microscopical sections of these plates exhibit no bone-lacunæ in the tissue of the middle layer ; and it has not been possible to make a satisfactory examination of the external layers. However, the extremely vascular character of the tissue seems to justify the reference of these fossils to an unknown large Ostracoderm ; and the writer is inclined to suspect that they may eventually prove to represent an ally of the genus *Ceraspis*, which occurs in the Devonian of the

Eifel. There is a large keeled plate of a very similar character from the neighbourhood of Gerolstein in the Museum of Comparative Zoology, Cambridge (Mass.); and evidence is gradually accumulating to prove that certain of the Ostracodermi attained comparatively gigantic proportions.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. *Acanthaspis decipiens*, sp. n.; associated dorsal (A) and ventral (B) shields. Lower Devonian, Dickson Bay. *a.v.l.*, anterior ventro-lateral; *b*, basal plate of pectoral appendage; *c*, impression of ridge and constriction on the visceral aspect of the posterior ventro-laterals; *m*, longitudinal lateral ridge (and supposed suture) on the dorsal shield; *m.v.*, median ventral; *p.v.l.*, posterior ventro-lateral; *s*, pectoral appendage; *x*, pair of descending processes on visceral aspect of dorsal shield; *y z*, line of transverse section, fig. 2.

Fig. 2. Ditto; transverse section of dorsal shield of the same specimen, along *y z*.

Fig. 3. Ditto; two transverse sections of the pectoral appendage of the same specimen, one (*a*) nearer the base than the other (*b*).

Plate II.

Fig. 1. *Pteraspis Nathorsti*, Lank.; hinder portion of ventral shield, visceral aspect. Lower Devonian, Dickson Bay.

Fig. 2. *Acanthaspis minor*, sp. n.; portion of occipital plate, visceral aspect, twice nat. size. Lower Devonian, Dickson Bay. *p*, median process of hinder border.

Fig. 3. Ditto; portion of pectoral appendage, associated with above, twice nat. size.

Figs. 4, 5. Ditto; two plates of the same, twice nat. size, outer and inner aspect respectively.

Figs. 6–10. *Porolepis posnaniensis* (Kade); scales. Lower Devonian, Klaas Billen Bay. Fig. 6 is inner aspect, nat. size; the others exhibit the outer aspect, twice or thrice nat. size.

Fig. 11. *Psammosteus arenatus*, Ag.; portion of bent plate, front view and transverse section (*a*). *Fig.* 11 *b*. Abraded tubercles of flat plate of ditto, enlarged. Upper Devonian, Mimers Valley.

Fig. 12. *Onychodus arcticus*, A. S. Woodw.; presymphysial bone, twice nat. size. Upper Devonian, Mimers Valley.

Plate III.

Fig. 1. *Asteroplax scabra*, g. et sp. n.; cranial shield. Upper Devonian, Mimers Valley. o, o_1, median plates; 1, 2, posterior and anterior paired plates; *x*, facial plate; *y*, *z*, undetermined plates.

Fig. 2. Ditto; problematical bone exhibited on the inferior aspect of the same specimen, two thirds nat. size.

The specimens are all preserved in the Royal Swedish State Museum, Stockholm, and unless otherwise stated the figures are of the natural size.

II.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91. By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. Alcock, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Plates VII. & VIII.]

On the 18th October, 1890, the 'Investigator' left Bombay for the Andaman Islands, and on the 9th December following she crossed from the Andaman Islands to the Madras coast, reaching Bimlipatam on the 26th December. During these passages fifteen hauls of the trawl were taken in depths ranging from 95 to 1997 fathoms, and numerous deep-sea soundings were made.

Between Bombay and Colombo, in the Laccadive Sea, numerous soundings were taken and four very successful trawlings were carried out. In this sea the bottom appears to be mainly green mud, with a small percentage of Foraminifera shells: in the immediate neighbourhood of the Laccadive Islands there is, of course, a great deal of fine coral detritus. The feature of these hauls were the starfishes, which will be duly noticed in the sequel.

Between Colombo and the Andamans three successful hauls of the trawl besides many soundings were taken. The deep open part of the Bay of Bengal here worked over shows a bottom of *Globigerina*-ooze with numerous water-worn fragments of pumice; but as one proceeds north-eastwards stiff blue mud is met with. The two deep hauls on this course gave a fine lot of starfishes and Holothurians. The third haul (Station 112), in 561 fathoms, must be particularly noticed. The trawl-bag came up crammed with mud of a low temperature, in which the specimens were imbedded. It may be surmised that compression under a great weight of cold mud kept up an approximation to normal bathybial conditions of temperature and pressure, in order to account for the fact that many of the crustaceans taken were found to be alive. Among these three species of Macrurous Decapods—*Aristæus*, sp. n., *Heterocarpus Alphonsi*, Sp. Bate, and *Willemoesia forceps*, A. M.-Edw.—were discovered to be luminous. In the case of *Heterocarpus Alphonsi* clouds of a pale blue highly luminous substance, which not only illuminated the

observer's hands and surrounding objects in the vessel in which the creature was confined, but also finally communicated a luminosity to the water itself, were poured out apparently from below the bases of the antennæ. The *Aristæus* was less, and less persistently luminous in the same region. The *Willemoesia* was luminous at two circumscribed points somewhere near the orifices of the genital glands.

In the Andaman Sea four good hauls were made. The bottom to the north appears to be in general blue mud; to the south there is a good deal of green mud. From experience in this and previous seasons the moderate depths of the Andaman Sea in its southern half appear to swarm with life. Station 114 (922 fathoms) in the Andaman Sea must have a special word of notice. The trawl-bag here again came on board choked with cold mud, out of which a gigantic specimen of *Colossendeis gigas*, Hoek, was washed alive. The ventral surface of the body and the ventral surfaces of all the legs except the ovigerous pair shone with a brilliant blue-green metallic lustre, which died away quickly from the body and part of the legs, but remained very persistently along the fifth and sixth segments of all but the first pair of legs.

Crossing the Bay of Bengal from the Andamans to Madras and on the continuation of the passage northwards to Bimlipatam four successful hauls were carried out; and between the parallels of 11° and 12° N. a continuous line of soundings was taken across the Bay. This section of the Bay shows a flat plain rising very abruptly to land on either side, the bottom being impure *Globigerina*-ooze (except, of course, near the land), with large water-worn fragments of pumice. The features of the deep hauls on this line were the magnificent starfishes and Holothurians.

Considering now the results of our trawling from the bathymetric point of view, without any reference to locality, we find that in the Indian seas the depths most favourable to animal life are the moderate depths at 100 to 400 fathoms. At this limit everywhere we find life to be varied and abundant, the fishes and Crustaceans especially being taken in swarms and in great variety.

The following is the list of the 'Investigator' deep-sea dredging stations during the season 1890–91 :—

Station No.	Position.	Depth in Fathoms.	Nature of Bottom.	Temperature Fahr.	
				Surface.	Bottom.
106	Laccadive Sea, lat. 9° 53′ 34″ N., long. 75° 16½′ E.	1091	Green mud, about 3 per cent. Foraminifera.	83°·5	37°·5
107	Laccadive Sea, lat. 8° 23′ N., long. 75° 47′ E.	738	Green mud.	79·5	41·9
108	Laccadive Sea, lat. 7° 04′ N., long. 76° 34′ 15″ E.	1043	Green mud, with Foraminifera.	80	38
109	Gulf of Manaar, lat. 7° 41′ N., long. 78° 21′ E.	738	Green mud.	81	42
110	Bay of Bengal, lat. 9° 34′ N., long. 85° 43′ 15″ E.	1997	*Globigerina*-ooze, with pieces of pumice.	81·3	35
111	Bay of Bengal, lat. 12° 50′ N., long. 90° 52′ E.	1644	*Globigerina*-ooze.	81	35·4
112	Bay of Bengal, lat. 13° 47′ 30″ N., long. 92° 36′ E.	561	Grey mud.	75·4	44·9
113	Andaman Sea, lat. 12° 59′ N., long. 93° 23′ 10″ E.	683	Blue mud.	76·5	42·9
114	Andaman Sea, lat. 13° 21′ N., long. 93° 27′ E.	922	Blue mud.	80·3	41·2
115	Andaman Sea, lat. 11° 31′ 40″ N., long. 92° 46′ 40″ E.	188–220	Green mud.	83	56
116	Andaman Sea, lat. 11° 25′ 5″ N., long. 92° 47′ 6″ E.	405	Green mud.	82	47
117	Bay of Bengal, lat. 11° 58′ N., long. 88° 52′ 17″ E.	1748	*Globigerina*-ooze, with pieces of pumice.	75·5	35·3
118	Bay of Bengal, lat. 12° 20′ N., long. 85° 8′ E.	1803	*Globigerina*-ooze, with pieces of pumice.	78·6	35
119	Bay of Bengal, off mouth of Kistna River.	95	Brown mud.	80	66·5
120	Bay of Bengal, lat. 15° 56′ 50″ N., long. 81° 30½′ E.	240–276	Brown mud.	79·1	52

Subgrade B. *CŒLOMATA.*

Phylum **VERTEBRATA.**

Class **PISCES.**

By A. Alcock.

The deep-sea fishes collected during the season number fifty species, of which twenty are new to science, while eight more have not before been recorded from India.

Among genera not typically bathybial hitherto unrecorded from Indian seas it is interesting to find *Callorhynchus?*, *Dibranchus*, *Peristethus*, *Physiculus*, *Ateleopus*, and *Neoscopelus*.

Among bathybial genera we have to record for the first time *Argyropelecus*, *Alepocephalus*, and *Nettastoma*.

The forms, five in number, which do not fall into any hitherto described genera are sufficiently important to require a separate notice.

1. *Malthopsis* is a Pediculate from the Andaman Sea very similar in general appearance and morphology to *Malthe* from the American side of the Atlantic, but differing from it in possessing only two pairs of gills.

2. *Halicmetus* is a still more remarkable Pediculate from the Andaman Sea. It is closely allied to *Dibranchus* and *Malthopsis*, but both dorsal fins are entirely wanting and the anal fin is rudimentary.

3. Another most remarkable type is *Lamprogrammus*, an Ophidiid very closely approximate to the Brotuline type, but separated off from it in having no ventral fins, and differing from all other Ophidiids in the structure of the lateral line, which resembles in appearance that of the Halosauridæ. That is to say, the scales of the lateral line are much enlarged, and each one is excavated for the reception of a glandular substance, which is probably luminous in function.

4. *Bathyclupea* is another extremely interesting form, which I have placed among the Physostomi and in the family Clupeidæ, though it differs from all the Physostomes in having the ventral fins, which are rudimentary, subjugular in position, and is unlike other Clupeoids in possessing few pyloric appendages and in having the upper jaw but indistinctly tripartite. I have carefully dissected this form, and have little doubt about its affinities, though I am not certain whether it should be placed apart in a new subfamily of the

Clupeidæ, or even in a new family next to the Clupeidæ. Admitting its present position, it is the first Clupeoid yet discovered in the depths.

5. *Dysommopsis* is a new Murænid closely allied to *Dysomma*, with which singular form it may be included in a new alliance. It differs most conspicuously from *Dysomma* in wanting pectoral fins.

Upon the new species of known genera a few general remarks may be made. Two species of *Dibranchus*—one from the Andaman Sea, the other from the Bay of Bengal—represent here a type hitherto known only from the African side of the Atlantic.

Callorhynchus, *Physiculus*, *Ateleopus*, and with them *Neoscopelus* and *Dibranchus*, may perhaps be looked upon as additional links in the chain which appears to connect the local bathybial fauna of the Bay of Bengal with the fauna on the one hand of the west Atlantic and on the other hand of the Japan seas.

In *Sebastes hexanema*, *Lioscorpius longiceps*, *Peristethus Murrayi*, and *Scopelus engraulis* we have further instances of the existence at moderate depths in the Indian seas of types discovered by the 'Challenger' at similar depths in the seas of the East-Indo-Australian Archipelago, such as our previous experience would lead us to anticipate.

A new species of *Harpodon* deserves a word of remark. It appears to be very near to *Harpodon microchir* from Japan, but differs from it and equally from *Harpodon nehereus* in its more complete squamation, the whole body and the greater part of the head being covered with thin rather deciduous scales.

Lastly, the discovery that the small Brotuline Ophidiid, *Saccogaster maculata*, the male of which is furnished with a bilobed external genital organ, is viviparous, though not particularly appertaining to bathybiology, is interesting enough to call for notice, for it confirms the opinions which have been formed of the function of similar appendages in the males of other Brotuline Ophidiids—e. g. *Dinematichthys iluocœteoïdes*, Blkr., and *Bythites fuscus*, Reinhardt.

The following is the list of the deep-sea fishes obtained during the season :—

Order CHONDROPTERYGII.

Suborder PLAGIOSTOMATA.

Family Scylliidæ.

Scyllium, M. & H.

1. *Scyllium hispidum*, sp. n.

Head broad and depressed. Snout flat and semicircular in outline, the length of its preoral portion is less than half its breadth, not much more than half the distance between the angles of the mouth and twice the interval between the non-confluent nasal valves, each of which bears a small cirrus. Eyes large, with the small spiracles situated behind and below them. A labial fold exists only at each angle of the crescentic mouth. Acutely tricuspid or quincuspid teeth in broadish bands in both jaws. The walls of the buccal cavity and the surface of the tongue are covered with small papillæ.

The entire skin, including that which covers the fins, is closely felted with spines, which are acutely tricuspid, with the middle cusp the longest—exactly resembling, but on a slightly smaller scale, the teeth.

The first dorsal fin, which begins just in advance of the vertical through the posterior limit of the base of the ventrals, is higher than the second, but about equal to it in extent of base. The anal, which terminates exactly opposite to the posterior limit of the second dorsal and very near to the origin of the caudal, is twice the length of either dorsal in extent of base. The pectorals are wide and are much longer and broader than the ventrals, which have a very oblique posterior margin.

Colour in life:—Uniform dull stone-grey.

One young male specimen, 9·5 inches long.

From Station 115, 188 to 220 fathoms.

Suborder HOLOCEPHALA?

2. *Callorhynchus*?, sp.

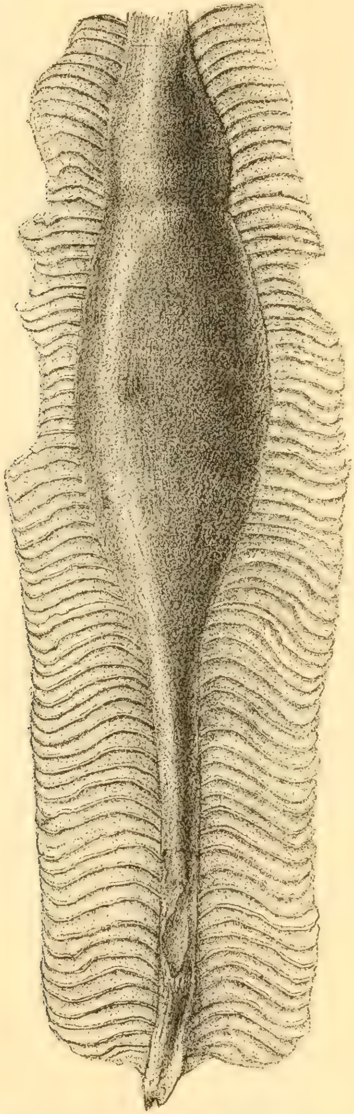
At Station 112, in a depth of 561 fathoms, an empty egg-capsule was dredged which we suppose to be that of either *Chimæra* or *Callorhynchus*, most probably the latter.

It is quite fresh, but has one end broken off. It is of a bottle-green colour and a parchment-like consistence, and measures as it is $5\frac{3}{4}$ inches in length.

It consists of an anterior ovate portion furnished anteriorly

with a bunch of very fine crimped silky hairs, and of a posterior tapering styliform portion, and the whole is surrounded by a broad radially striated or plicated fringe.

Fig. 1.



It is hardly to be supposed that this egg-capsule has drifted from any great distance.

Order ACANTHOPTERYGII.

Family **Scorpænidæ**.

SEBASTES, Gthr.

3. *Sebastes hexanema*, Gthr.

Sebastes hexanema, Günther, 'Challenger' Shore-fishes, p. 40, pl. xvii. fig. B; and 'Challenger' Deep-sea Fishes, p. 18.

Two specimens of this species, which was originally described from the Arafura Sea, 140 fathoms, were taken by the 'Investigator' at Station 115, 188 to 220 fathoms.

LIOSCORPIUS, Gthr.

4. *Lioscorpius longiceps*, Gthr.

Lioscorpius longiceps, Gthr., 'Challenger' Shore-fishes, p. 40, pl. xvii. fig. C.

This also is a hemibathybial species from the Arafura Sea, where it was taken along with the preceding species by the 'Challenger.'

One specimen was taken at Station 115, 188 to 220 fathoms. It has four large pyloric cæca.

Family **Berycidæ**.

MELAMPHAËS, Gthr.

5. *Melamphaës*, sp.

Some small specimens mutilated beyond identification were taken at Station 111, in 1644 fathoms, and Station 118, in 1803 fathoms.

POLYMIXIA, Lowe.

6. *Polymixia nobilis*, Lowe.

Two specimens of this well-known deep-sea Berycoid were taken at Station 115, 188 to 220 fathoms.

Family **Carangidæ**.

BATHYSERIOLA, Alcock.

7. *Bathyseriola cyanea*, Alcock.

Bathyseriola cyanea, Alcock, Ann. & Mag. Nat. Hist. ser. 6, vol. vi. (1890), p. 202.

A single specimen was taken at Station 120, in 240 to 276 fathoms.

Family **Pediculati.**

HALIEUTÆA, C. & V.

8. *Halieutæa nigra*, sp. n.

D. 5. A. 4. C. 9. P. 13. V. 1/5.

Cephalic disk circular, convex anteriorly. Rostral tentacle trilobed. Interorbital space concave; supraorbital margin with long aculeate spines.

Cleft of mouth horizontal, its width being considerably less than half the diameter of the disk; jaws with villiform teeth. Gills $2\frac{1}{2}$. The dorsal surface of the disk and tail bears scattered spines with stellate bases, bifid, trifid, or multifid along the edge of the disk and side of the tail, but elsewhere acicular; the abdominal surface is covered with minute granules only. A few small papillæ along the under surface of the lower jaw; but no other cutaneous appendages. Fins in form and disposition as in *H. stellata*; the length of the pectorals is nearly twice that of the ventrals and about equal to that of the caudal, which is one fourth of the total.

Intestine wide; no pyloric cæca; no air-bladder.

Colour in life:—Uniform blue-black, with jet-black vermicular lines.

One specimen 2·7 inches long, from Station 115, 188 to 220 fathoms.

It is possible, though hardly probable, that this may be an immature form of *Halieutæa coccinea*, mihi. The difference in colour appears not to be an objection, because in a species of *Peristethus* to be described the young are dusky violet in colour, while a large specimen is bright red.

DIBRANCHUS, Peters.

9. *Dibranchus nasutus*, sp. n. (Pl. VII. fig. 1.)

B. 5? D. 6. A. 4. C. 9. P. 12–13. V. 1/5.

Head and anterior part of body forming a large flat semicircular disk as broad as long; tail cylindrical. The broadly expanded snout-bones project far beyond the deep semicircular cavity which lies beneath them, and this lodges a fleshy tentacle, which ends in a pair of spherical lobes surmounted by a median bifid filament. A pair of almost confluent nostrils on each side of the subrostral cavity. Eyes small. Mouth-cleft horizontal, its width is about one third the greatest breadth of the cephalic disk; tongue large, blotched

with dusky pigment; villiform teeth in the jaws only. Gill-cleft a small foramen situated superiorly in the axilla; two gills; no pseudobranchiæ.

Dorsal surface of the cephalic disk and entire surface of the tail covered with stout spines, which are marked with numerous trenchant radiating costæ; those on the tail and in three series along the margin of the disk are widely bifid, those elsewhere are acicular. Under surface of the cephalic disk without spines, but with distant granular tubercles. Fins in form and disposition as in *Dibranchus atlanticus*; the pectorals and caudal are coequal in length, being contained $4\frac{1}{2}$ times in the total, and are slightly longer than the ventrals.

A wide coiled intestine; no pyloric cæca; no air-bladder.

Colours in life:—Blue-black, edge of disk and anterior part of abdomen jet-black.

One specimen 3·2 inches long, from Station 115, 188 to 220 fathoms.

10. *Dibranchus micropus*, sp. n.
(Pl. VII. figs. 2, 2 *a*, 2 *b*.)

D. 5. A. 4. C. 9. P. 15. V. 5?

Head and anterior part of body depressed, forming a disk which is nearly as broad as long and is truncated in front; there are strong, sharp, simple and bifid spines along its margin, and at the subopercular angle a large trifid one.

The broad front, which is so abruptly truncated as to leave no appearance of a snout, is widely but not deeply excavated below for the lodgment of a large fleshy supra-oral tentacle; this is trilobed, the lateral lobes being smoothly hemispherical and the middle (superior) lobe being foliaceous, with a fringed margin. On each side of the subrostral cavity are the large exsert subtubular nostrils. Eyes small.

Mouth-cleft horizontal; its width is contained about $2\frac{1}{3}$ times in that of the disk; jaws with a row or very narrow band of minute teeth. Gill-cleft a small foramen situated superiorly in the axilla and barely wider than the nostril; two gills only.

Entire surface of body closely covered with fine, short, bristle-like spines, which have stellate bases and either simple or bifid points.

Fins in form and position as in *Dibranchus atlanticus*; the pectorals are large, being as long as the caudal, which in the specimens under examination is nearly as long as the rest of the tail; the ventrals are minute.

No pyloric appendages; no air-bladder.

Colour in life uniform blue-black.

Two specimens, the larger of which is 2·6 inches long, from Station 120, 240 to 276 fathoms.

MALTHOPSIS, gen. nov.

As *Malthe*, but with only two gills on each side.

11. *Malthopsis luteus*, sp. n. (Pl. VIII. figs. 2, 2 *a*.)

B. 5. D. 5. A. 4. C. 9. P. 11. V. 1/5.

Head and anterior part of body much depressed, forming a triangular wedge, the base of which is surmounted by a stout, fluted and crenulated, projecting, spinous prolongation of the snout, somewhat as in *Malthe*.

Beneath this nasal prolongation is a deep narrow vault, flanked on each side by a pair of large, almost confluent nostrils, and containing a short, fleshy, clavate tentacle.

Eyes large, lateral, nearly circular; their diameter is about one seventh of the total length, caudal not included; they are strongly convergent and anteriorly are barely half a diameter apart; the anterior limit of the orbit is in the same vertical line with the anterior limit of the mouth.

The mouth-cleft, which is horizontal, is about two thirds of an eye-diameter in width. Teeth villiform, in bands in the jaws and in broad patches on the vomer and anterior ends of the palatines.

Gill-cleft a small foramen, in width about one fifth of an eye-diameter, situated superiorly in the axilla; two gills; no pseudobranchiæ. Suboperculum prolonged and ending in a stout trifid or multifid spine.

Body covered with hard granular adherent plates, each with a large radially-striated conical tubercle in its centre. On the dorsal surface of the cephalic disk they are of moderate size, in contact along the middle line, but distant and slightly sunken laterally; on the ventral surface of the cephalic disk they are small, distant, and sunken; on the rest of the trunk and tail they are large and in close contact throughout.

The form and disposition of the fins is as in *Malthe*; the ventrals are very long, nearly equal to the pectorals, which are equal to the caudal, which is two ninths of the total.

A large siphonal stomach is found, and a wide coiled intestine, opening widely in the middle line between the axillæ. No pyloric cæca; no air-bladder.

Colours in life:—Pinkish yellow; some specimens with a few irregular rings of dark chocolate on the dorsum of the cephalic disk.

There are five abdominal and thirteen caudal vertebræ, the neural spines of the former being coalescent into a trenchant ridge as in *Malthe* and *Halieutœa.*

Ten specimens were taken at Station 115, in 188 to 220 fathoms. They vary in length from 1·4 to 2·9 inches; and in the younger specimens the subopercular spine is relatively much larger and the pectoral fins are of greater relative length —being contained 3½ times in the total length, caudal included.

HALICMETUS, gen. nov.

Head and anterior part of body very broad and depressed. Front with a transverse bony bridge and a subrostral cavity lodging a fleshy tentacle. Cleft of mouth horizontal. Villiform teeth in jaws and palatines. Gill-openings small foramina situated superiorly in the axillæ; two gills; no pseudobranchiæ. Head and body with close-set graniform asperities and large granular tubercles. No dorsal fin whatever. Anal fin very short. Pyloric appendages and air-bladder absent.

12. *Halicmetus ruber*, sp. n. (Pl. VIII. figs. 1, 1 *a*, 1 *b*.)

B. 5? D. 0. A. 3. C. 9. P. 11. V. 1/5.

Head and anterior part of trunk depressed, forming a semicircular disk rather broader than long, with a slight convexity in the cranial region. The truncated snout is occupied, as in *Halieutœa*, by a bony rugose orbital bridge, beneath which is a cavity lodging a fleshy tentacle which ends in three lobes, the middle (superior) lobe being crested by a small bifid filament. The eyes are small and convergent.

The nostrils are minute papillæ situated on each side of the rostral tentacle, within the subrostral cavity.

Mouth horizontal, with the lower jaw slightly projecting; its cleft is a little wider than the eye. Villiform teeth in bands in the jaws and on the palatines.

Gill-cleft a small foramen, less than half an eye-diameter in width, situated superiorly in the axilla; two gills; no pseudobranchiæ. The suboperculum ends in a stout multifid spine.

Surface of the body uniformly invested with minute close-set graniform spines, which also cover the eyes up to the

corneal margin. The edge of the cephalic disk bears in addition large finely granular multifid spines in three longitudinal series, and the tail is clad with large granular conical tubercles—of which there are five longitudinal series on each side—in close contact.

Fins in form and position as in *Halieutæa*, *Malthe*, &c., but the soft dorsal, as well as the spinous, is entirely wanting, and the anal is almost rudimentary. The pectorals, which are about a third longer than the ventrals and a little longer than the caudal, are nearly one fifth the total length.

Stomach large, siphonal, much constricted at the pylorus. Intestine coiled and very wide. No pyloric cæca. No airbladder.

Colour in life uniform light pink.

Two specimens, measuring 2·75 inches in length, from Station 115, 188 to 220 fathoms.

Family **Cataphracti.**

13. Peristethus, Kaup.

Peristethus Murrayi, Gthr.

Peristethus Murrayi, Günther, 'Challenger' Shore-fishes, p. 52, pl. xxxii. fig. A.

A single adult specimen from Station 115, 188 to 220 fathoms, and two young ones. The young ones in life were of a uniform dusky violet colour, the colour of the adult being red. The young also differ from the adult in having three small upstanding points, disposed in a triangle, on the forehead.

Order ANACANTHINI.

Family **Gadidæ.**

Physiculus, Kaup.

14. *Physiculus roseus*, sp. n.

B. 7. D. 7/57. A. 55. V. 7.

Head and trunk broad; tail compressed, higher than the trunk anteriorly. Length of the head very nearly one fourth of the total, including the caudal; its breadth, which exceeds its height, is a good deal more than half its length. Greatest height of the body, just behind the origin of the dorsal fin, about one sixth of the total.

Snout depressed, broader than long, obtusely rounded; its

length, which is equal to the major diameter of the eye and slightly exceeds the width of the flat interorbital space, is one fourth that of the head. Nostrils superior, situated immediately in front of the orbit.

Mouth wide, oblique, with the upper jaw overlapping the lower; the maxilla reaches beyond the vertical through the middle of the orbit. Teeth villiform, in broadish bands in the jaws only.

Barbel stout, about as long as the eye.

Gill-openings very wide.

Body and head covered with a thick mucilaginous skin, which is invested everywhere with small deciduous scales, of which there appear to be six rows between the first dorsal fin and the lateral line. The dorsal and anal fins, which are invested with a fold of thick scaleless skin, extend to within an eye-length of the caudal. The first dorsal, which is separated from the second only by a notch, begins in the vertical through the base of the pectoral; its first ray is prolonged and nearly equals the postrostral portion of the head in length. The ventrals arise on flattened bases; their outer ray is prolonged beyond the origin of the anal. The pointed pectorals arise on oblique bases; their length is not quite equal to that of the prolonged ventral ray.

The vent is situated well in advance of the origin of the anal fin, and there is a small postanal papilla. A large air-bladder exists.

Colours in life uniform rose-red.

One specimen, 7 inches long, from Station 115, 188 to 220 fathoms.

BREGMACEROS, Thompson.

15. *Bregmaceros*, sp.

Numerous young specimens were obtained at Station 119, in 95 fathoms.

Family **Ophidiidæ.**

MONOMITOPUS, Alcock.

16. *Monomitopus nigripinnis*, Alcock.

Sirembo nigripinnis, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 384.
Monomitopus nigripinnis, id. ibid. Oct. 1890, p. 297.

One well-preserved specimen, $6\frac{1}{4}$ inches long, from Station 112, 561 fathoms.

NEOBYTHITES, Goode & Bean.

17. *Neobythites macrops*, Gthr.

Neobythites macrops, Günther, 'Challenger' Deep-sea Fishes, p. 102, pl. xx. fig. A.
Neobythites macrops, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 385.

Twenty specimens, varying in length from 4 to $8\frac{1}{2}$ inches, were taken at Station 115, 188 to 220 fathoms.

18. *Neobythites pterotus*, Alcock.

Neobythites pterotus, Alcock, Ann. & Mag. Nat. Hist. Sept. 1890, p. 210, and Oct. 1890, p. 297.

A very fine male specimen, 1 foot long, from Station 117, 1748 fathoms. It differs from the large female captured last year in the Laccadive Sea in having the pectoral fin-rays very much more prolonged—reaching to the tenth anal ray—and spatulate at the ends. In the female the pectoral fin-rays reach only to the first anal ray.

SACCOGASTER, Alcock.

19. *Saccogaster maculata*, Alcock. (Pl. VII. fig. 3.)

Saccogaster maculatus, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 389.

An adult male specimen, just over $3\frac{1}{2}$ inches long, from Station 120, 240 to 276 fathoms. The male has a large bilobed postanal papilla, and into the sulcus between the lobes the seminal duct opens. The female, it now appears from a reexamination of the type described in 1889, has the distended ovaries full of developing embryos, so that we now know *Saccogaster maculata* to be a viviparous fish; and we may conclude that the postanal papilla is an intromittent organ of copulation.

PARADICROLENE, Alcock.

20. *Paradicrolene nigricaudis*, sp. n.

B. 8. D. circ. 90. A. circ. 75. C. 8?
P. 19–20/6–7. V. 2.

Head conoid; its length about $4\frac{1}{2}$ in the total, with the caudal; its height $\frac{2}{3}$, its breadth $\frac{1}{2}$ its length; all its bones strong.

Body and tail compressed; the height of the former is nearly one fifth the total, with the caudal. Operculum with a sharp spine above, preoperculum with three flat spines radiating from its angle.

Snout broad and rounded, not overhanging the jaw; its length, which is equal to the major diameter of the eye or to the width of the convex interorbital space, is contained about $4\frac{1}{2}$ times in that of the head. The anterior nostril is a small foramen near the tip of the snout, the posterior is a moderate-sized elliptical opening in front of the angle of the eye.

Cleft of mouth wide, oblique; the dilated scaly extremity of the maxilla reaches half an eye-length behind the vertical through the posterior border of the orbit; the lower jaw is included within the upper in repose, and has a large pore on either side of the symphysis. Villiform teeth in bands in the jaws, palatines, and vomer.

Gill-opening wide; pharyngo-branchial membrane partially pigmented; eleven long gill-rakers on the outer side of the first branchial arch, besides small ones above and below; pseudobranchiæ reduced to two small pinnules.

Body and entire head, including even part of the branchiostegal membranes, covered with small adherent scales, of which there are four rows between the base of the dorsal fin and the lateral line, which is a distinct poriferous groove ending in the posterior fourth of the tail.

Dorsal and anal fins invested in a thick fold of integument, which is scaly in its basal half. The caudal, which is nearly half the length of the head, is adherent to the other vertical fins at its base only. Pectorals very broad, with fleshy scaly bases, pointed, slightly longer than the postrostral portion of the head; the lowermost six or seven rays are incompletely detached from the rest of the fin and from each other at their bases, and are produced each into a long free filament, of which the longest (uppermost) in large specimens is twice the length of the fin. Ventrals separated by a considerable interval; each consists of two separate stout filaments, the outer of which is the longer and exceeds in length the post-orbital portion of the head.

Parietal peritoneum black; stomach siphonal; intestine long and coiled in several wide loops; no pyloric cæca; an air-bladder.

Colours in life:—Chocolate, posterior third of tail, including the vertical fins in that space, black; caudal fin and pectoral filaments milk-white.

Five specimens, the largest nearly 8 inches long, from Station 115, 188 to 220 fathoms.

21. *Paradicrolene multifilis*, Alcock.

Paradicrolene multifilis, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 387.

Several small specimens, slightly differing in unimportant characters—*e. g.* in the colour of the body, which is much darker—from the type, were taken at Station 120, 240 to 276 fathoms.

Dermatorus, Alcock.

22. *Dermatorus melanocephalus*, sp. n.

This species is very closely allied to *Dermatorus trichiurus* from the Laccadive Sea (Ann. & Mag. Nat. Hist., Oct. 1890, p. 298), from which it differs in the following points:—

All the spines of the head-bones are weak and flexible; the opercular spine is broad, flat, and weak; the preopercular border is double, but smooth and unarmed; the humeral spine is almost obsolete; the length of the snout is one third that of the head, twice the major diameter of the eye, and greater than the width of the interorbital space; the maxilla is not quite two thirds of the head in length; there are only fifteen elongated gill-rakers on the outer side of the first branchial arch; there are no pseudobranchiæ whatever.

Colours in the fresh state transparent grey; head and belly black.

The intestine is long and much coiled, and there are a few rudimentary pyloric cæca in a ring round the pylorus.

Length nearly 8 inches.

One specimen from Station 111, 1644 fathoms, and one from Station 117, 1748 fathoms, both being mature females.

Lamprogrammus, gen. nov.

Head large, body compressed, both entirely covered with thin, smooth, deciduous scales of moderate size. Head-bones with prominent crests and wide muciparous cavities, unarmed except for a weak opercular spine. Snout not overhanging the jaws. Eye of moderate size. Mouth large; teeth in villiform bands in the jaws, palatines, and vomer. No barbel or hyoid filaments. Gill-opening wide; gill-membranes separate; four gills, eight branchiostegals, no pseudobranchiæ. *Lateral line very conspicuous, with much enlarged scales, each of which bears a glandular (luminous) organ.* Vertical fins confluent; pectoral fins entire; *no ventral fins.*

23. *Lamprogrammus niger*, sp. n.

B. 8. D. circ. 110. A. circ. 90. C. 10? P. 17. V. 0.

Tissues fragile. Head large, body compressed, tail compressed and tapering. The head, the length of which is about one fifth of the total, or slightly over half the length of the entire head and trunk in the adult, or a little more than the greatest body-height, has the bones weak and furnished with prominent flexible crests, the intervals between which form wide and capacious muciparous cavities; its only armature is a flat inconspicuous spine on the upper part of the operculum.

The snout, which is broad and rounded, does not overhang the jaws; its length is slightly less than the width of the convex interocular space and $2\frac{1}{2}$ times the diameter of the circular eye, which last is about one ninth the length of the head.

Mouth cavernous, with oblique cleft and jaws nearly conterminous in front; the maxilla, which is much dilated posteriorly, is half the length of the head. Villiform teeth in broad bands in the premaxillæ and in very narrow bands in the mandibles, palatines, and V-shaped head of the vomer.

Gill-openings very wide, the gill-membranes not at-

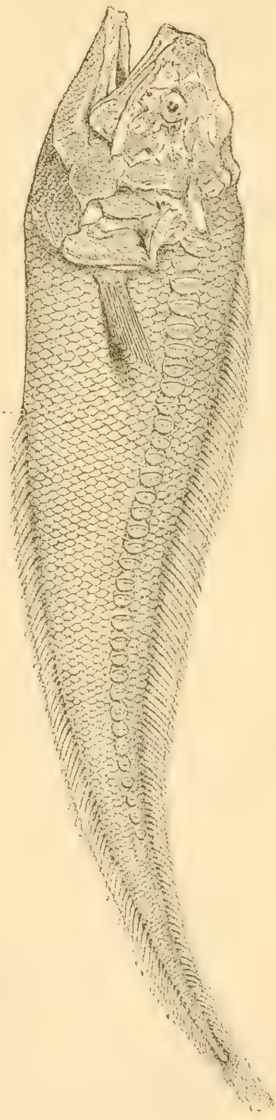


Fig. 2.

Lamprogrammus niger. × ½.

tached to the isthmus; four gills with narrow laminæ and scabrous clavate gill-rakers, which, to the number of about ten, are a little elongated on the outer side of the first arch; no pseudobranchiæ.

Body and head, including the glosso-hyal region and the branchiostegal membranes, covered with deciduous membranous cycloid scales of moderate size.

The scales of the very conspicuous lateral line are adherent and greatly enlarged; they lie beneath a continuous sheath of black skin, which is loopholed over a long narrow groove with raised margins situated along the vertical diameter of each scale. These grooves are filled with an opaque white substance, which probably has a luminous function. The lateral line, in fact, is exactly similar to that of several species of *Halosaurus*.

The dorsal fin, which begins just in advance of the gill-opening, and the anal, which begins almost a head-length behind the same level in the adult, are confluent with the pointed caudal. The narrow, pointed pectorals are as long as the rostrorbital portion of the head. There are no ventral fins whatever.

The stomach is siphonal, with a bulbous pyloric end; the intestine, which is very long, is looped and coiled, the loops being held by a stout mesentery; there are six small cæca in a semicircle round the pylorus; no air-bladder can be detected.

Colours in the fresh state uniform jet-black.

Two females, 15·5 and 11·75 inches long respectively, from Station 112, 561 fathoms; a third specimen from Station 116, 405 fathoms.

This extraordinary form seems almost entitled to rank by itself in a separate subfamily of the Ophidiidæ. In general appearance and in most of its structural details it has the closest resemblance to the typical *Brotulina*; but it differs from them all in its remarkable *Halosaurus*-like lateral line and in the entire absence of ventral fins.

[To be continued.]

III.—*Notes concerning the Anatomy of certain Rotifers.* By Rupert Vallentin.

[Plates IV. & V.]

It was originally my intention to prepare for publication a series of papers concerning the anatomy of some of our larger species of common Rotifers whose structure I had been able

to examine by means of serial sections. After making a careful study of my sections I soon saw that some features which were plainly visible in one Rotifer were often indistinguishable or nearly so in the remaining specimens; hence I deemed it necessary to gather what remarks I had to offer into a single communication.

Having resided for some years in the neighbourhood of Epping Forest, where, in the numerous ponds, one has no difficulty in securing at most times of the year such well-known forms as *Melicerta ringens*, *Stephanoceros*, &c., I was astonished on taking up my residence in Cornwall to find these Rotifers absent from the numerous ponds in the county, and at first imagined that a more diligent search was only necessary to secure them. However, after examining during the past two years at fixed intervals a large number of ponds and pools to all appearances most favourably situated, I have, up to the present time, been only able to find *Brachionus rubens* in any quantity.

Within the past six months I introduced into a pond in the neighbourhood of Falmouth some fine healthy specimens of *Melicerta conifera* procured from Epping Forest. The weed, *Chara vulgaris*, to which the cases containing the Rotifers were attached, flourished and grew luxuriantly; but the Rotifers soon died from some cause I am unable to discover. This fact may in some measure be due to the mildness of the climate here, frosts of any degree of severity being unknown.

The specimens whose structure I have examined by means of serial sections are as follows:—*Melicerta ringens*, *M. conifera*, *Brachionus rubens*, and *Lacinularia socialis.*

I propose in the following paper to discuss in as brief a manner as possible the various points of interest that have presented themselves to me during a close examination of sections of the above-named Rotifers, and to refer the reader to Dr. Hudson's monograph (1)* for a detailed account of each species.

Nervous System.

Melicerta ringens and *M. conifera.*
(Pl. IV. figs. 1–8.)

A close examination of serial sections has failed to reveal to me any material difference between these two species as regards the structure of the central nervous system.

M. Joliet (2) was the first investigator who discovered the

* The numbers refer to Bibliographical List at end.

central nervous system in *Melicerta ringens.* He says:—"Sur la face dorsale du pharynx, immédiatement au-dessus de l'amas glandulaire dépendant du système excréteur, se voient deux ou quatre cellules transparentes qui occupent précisément la position où l'on a décrit le ganglion chez tous les Rotateurs où il a été vu. Elles sont pourvues d'un noyau volumineux qui leur donne beaucoup l'apparance d'une cellule nerveuse et deux d'entre elles envoient un filet à l'organe tactile impair."

I have placed in my illustrations a section taken through the middle of the brain and surrounding parts of *M. conifera.* I have selected this Rotifer mainly on account of its size and the ease with which one can see the nerve-cells. In *M. ringens* the brain is, as stated by M. Joliet, small, the nerve-cells being not nearly so numerous as in *M. conifera* (*vide* Pl. IV. figs. 2–4 and the accompanying explanations).

Lacinularia socialis. (Pl. V. figs. 9–13.)

Dr. Hudson in his monograph gives a summary of our present knowledge concerning the nervous system of this species. He says (*loc. cit.*), "Prof. Huxley describes and figures a ciliated cup beneath the chin, just as in *M. ringens*; and below this cup, underneath the surface on the ventral side 'a bilobed homogeneous mass resembling in appearance the ganglion of *Brachionus.*' This organ he supposes to be the true nervous ganglion. Dr. Leydig, on the other hand, points out two nucleated polar cells, giving off threads, just below the mastax, and two similar ones at the junction of the foot and trunk."

According to my observations I find a group of nerve-cells placed immediately beneath the transverse band which connects above the mouth the paired lateral excretory tubes (*vide* Pl. V. fig. 12). This group of cells consists of unipolar ganglion-cells. On reference to fig. 12 and the accompanying explanation it will be further noticed that from the dorsal edge of this nervous mass nerve-fibres are given off which ultimately terminate in one of those large cells placed at regular intervals along the inner edge of the corona, and classed under the head of "vacuolar thickenings" by Prof. Huxley (3).

Prof. Huxley says concerning these "vacuolar thickenings" as follows:—" . . . the thickenings in the trochal disk are mostly towards its lower surface and at its inferior margin; they are generally four or five on each side, and are connected by branched filaments with that body on each side of the pharyn-

geal mass in which the band of the water-vascular system terminates." In this species of Rotifer tactile organs have never been observed; I take these "vacuolar thickenings" to be nerve sense-cells and to perform the function of tactile organs. Occupying the position they do, on any foreign body coming into contact with the expanded edge of the corona the stimulus would be immediately conveyed through these marginal sense-bodies along the nerves and so to the brain. There is, however, a very close connexion between the marginal sense-cell and the dilated portion of each lateral canal in the corona. I have, however, satisfied myself that the nerve-fibre in each instance runs over the dilated portion of the lateral canal and so joins the brain. Be this as it may, cells similar in structure but not showing any connexion with the central nervous mass are also visible in the trochal disk of *Melicerta ringens*, *M. conifera*, and *Brachionus rubens*.

Attention may here be directed to a group of cells placed in the region of the anterior third of the foot. Dr. Leydig (4) gives a very exact representation of these cells as seen in optical section. From a close scrutiny of Dr. Leydig's figure one would be inclined to imagine that these cells were placed immediately beneath the cuticle of the animal. Serial sections, however, show these cells to be grouped together in the central space (body-cavity) of the foot, the longitudinal muscles with the mucous cells forming a complete wall round them (*vide* Pl. V. fig. 9). Each cell is seen to be oval in outline and possessing a nucleus and nucleolus. Anteriorly and posteriorly from each cell processes are given off, the processes from the anterior region of each cell being lost in the viscera, while posteriorly they appear to unite with the muscles forming the attached extremity. These processes are so extremely fine as to render it difficult for one to trace them to their destination. Dr. Leydig takes these cells to be nervous in function. Dr. Hudson (*loc. cit.*), after giving a summary of the researches of previous investigators concerning the position of the known nervous centres in other Rotifers, seriously questions Dr. Leydig's statement concerning the function of the cells in question. At present I think we must own we are unable to offer any satisfactory explanation concerning their function.

Muscular System.

Melicerta ringens and *M. conifera*.
(Pl. IV. figs. 1–8.)

So far as I can discover there is no difference in the

arrangement and distribution of the muscles in these two species.

Prof. Williamson (5) says, "Distinct muscular bands occur at intervals in the common tegument, concentrically encircling the entire organism. Their action is easily observed. Still larger and more distinct fasculi run lengthwise; some of these proceed from the upper part of the visceral cavity to the base of the tail or peduncle, where they are inserted into a thickened portion of the integument. Others, taking their rise from the various parts of the body, proceed along the caudal prolongation, and are inserted into a little concavo-convex body at its extremity."

Dr. Hudson says, "The longitudinal muscles, as in the Flosculariadæ, run up the foot to its junction with the trunk, where they are fastened. They then cross the trunk till they reach the neck, where they are again fastened; and as they reach the head they divide into branches, which cross the lobes of the corona, and, by their contraction, furl it. Transverse muscles, imbedded in the integuments, encircle the trunk; and, by the compression of the body-fluids, drive out and unfurl the corona, just as in *Floscularia*."

M. Joliet gives, according to my observations, the most exact description of the arrangement and number of muscles in this species. He says, under this heading, "Il se compose principalement de huit cordons musculaires, qui vont s'insérer, d'une part, à l'extrémité de la queue qu'ils parcourent dans toute sa longueur, et de l'autre symétriquement à différents niveaux sur la face ventrale, sur la face dorsale, et sur les côtés du corps."

On reference to fig. 7 and the accompanying explanation one cannot fail to notice that the muscles in the foot of this species are arranged in a manner distinctly different to that of any ordinary tube-dwelling Rotifer; and, further, the muscles present in transverse section an almost crescentric outline, appearing to be united by sarcolemma only when viewed in longitudinal section. It will also be noticed that the muscles are placed some distance from the cuticle and not arranged in any order, but appear to move freely in the large body-cavity space in the foot. As to whether or no these features are in any way caused by the reagents used I am unable to determine; still all my sections agree as to these points. Posteriorly, owing to the tapering form of the foot, the muscles tend to converge, and in the region of the posterior third they unite and form the attached extremity. At the junction of the foot with the trunk the muscles form the usual four pairs, and, continuing anteriorly, remain unaltered

till the region of the anterior third is reached. In this latter region the muscles break up and terminate at the base of the corona. Owing to their extreme fineness I am unable to trace these muscles with any degree of exactness in this region. One point, however, is certain; the fibres terminate in a large muscular band placed at the base of the corona.

I may here add in conclusion that I have been unable to discover any traces in section of the circular muscular bands which so many investigators have seen in optical section.

Lacinularia socialis. (Pl. V. figs. 9–13.)

Prof. Huxley in his paper does not appear to notice beyond a brief reference the muscles in this Rotifer; Dr. Leydig, on the other hand, treats this subject in an exhaustive manner. He says (*loc. cit.*): "Es sind vier Längenmuskeln, welche sich durch den ganzen Körper ziehen, von der Spitze des Schwanzes bis zum Rande des Räderorganes und welche die Hauptbewegung des Thieres besorgen, das sich Verkürzen und Einstülpen. Sie sind nicht gleich dick nach ihrer ganzen Ausdehnung: im Schwanzanhang und im Hinterleibe beträgt ihr Durchmesser 0·004‴, nach vorne zu verjüngen sie sich allmälig, und wenn sie einmal in das Räderorgan eingetreten sind, so gehen sie strahlig auseinander zum Rande desselben." He then proceeds to notice certain circular muscles. He says: "Der Leib des Thieres wird auch ringförmig eingeschnürt. Dieses bewerkstelligen eine Anzahl Ringmuskeln, welche in Abständen unter der Haut herum laufen; sie sind viel feiner als die Längenmuskeln, haben auch nie eine Querstreifung, sondern zeigen sich nur als durchaus homogene Fäden. Die einzelnen Ringmuskeln scheinen auch untereinander durch zarte Ausläufer verbunden zu sein."

Serial sections have failed to reveal to me any trace of these circular muscles encircling the body in any way.

I find the arrangement of the muscles in the foot of this species to differ but in a slight manner from that of *Stephanoceros*.

Examining a transverse section taken immediately beneath the junction of the foot with the trunk (*vide* Pl. V. fig. 9), the muscles are found to be six in number, the interspaces being occupied by a prominent mucous cell. It will be further noticed that the muscles are not placed immediately beneath the cuticle, but occupy a position slightly removed from it.

At the junction of the foot with the trunk each muscle divides into two parts. These muscles continue to run anteriorly immediately beneath the cuticle without any visible

alteration, and terminate at the base of the corona or trochal disk.

Alimentary Canal.

Melicerta ringens and *M. conifera.* (Pl. IV. figs. 1–8.)

All previous investigators have noticed a paired structure visible above the mastax. It is found to be present in the majority of Rotifers. Dr. Hudson (1) says concerning this structure in *M. ringens* as follows:—"On each side of the buccal funnel and above the mastax is a clear organ whose surface is spheroidal. The two have been described as salivary glands by some observers, and as mere stays to the mastax by others. They are obviously elastic, and move up and down with its every motion." Although these paired structures are easily distinguishable in the Rotifers included in the present paper, I find their structure most easily deciphered in *Melicerta conifera.* It is my intention to take this species as an illustration and to describe the structure of these bodies as briefly as possible.

On reference to Pl. IV. figs. 1 and 2, which are serial sections, it will be noticed that, placed immediately above these "spheroidal bodies," are certain glandular cells; the protoplasm being wanting in many instances, these cells were probably in an active state of secretion at the death of the animal. Attached to the inner wall of each "spheroidal body," or, as I shall in future call it, salivary receptacle (for that is what I take them to be), is a valvular body, which places the cavity of each receptacle in immediate connexion with the gut (fig. 2, *a*). It will also be noticed that there is a slight deposit of secretion visible within each salivary receptacle. Dr. Hudson noticed these valvular openings. He says, "It [the buccal funnel] is ciliated throughout, and has a pair of chitinous lips similar to those described at p. 6." The reference given refers to a lengthened description of these structures as they are found in *Brachionus rubens.* Dr. Hudson here says, "But it is not every atom whirled down the buccal funnel that is suffered to reach the mastax; for there are two lip-like processes rising from the mastax, which can be seen every now and then thrust up and down the buccal funnel; and which by closing prevent the passage of morsels that are not to the Rotiferon's taste."

It seems to me highly probable that Dr. Hudson has slightly misplaced the point of attachment of these valvular

or lip-like processes. On reference to fig. 2 it will at once be evident that the real point of attachment of these bodies is on the outer or ventral edge of each salivary receptacle. In addition to this the same figure also shows a connexion between the salivary receptacle (on the left side facing the observer) and the gut. The connexion which exists on the right side is not shown in the drawing, owing to the section not being exactly transverse.

In my opinion the series of complicated movements so exactly described by Dr. Hudson is none other than the opening and closing of these valvular bodies, to allow the secretion to flow into the gut as food is passing, in order to assist digestion.

Prof. Williamson (5) mentions in his paper a structure which seems to have eluded the scrutiny of observers ever since. He says, "Two or three pyriform glandular (?) looking bodies are often attached to the base of the upper stomach, near the constriction which separates it from the lower one. . . . Not having been able to trace any ducts or orifices passing from these organs to the viscera, I have hesitated to assert their glandular character." Dr. Hudson does not appear to have seen these bodies, as he fails to notice their presence.

I have placed in my illustrations a view of this group of cells as seen in longitudinal section to confirm Prof. Williamson's discovery (*vide* fig. 8). At present I am unable to offer any suggestion as to what function they perform, as I have failed to find any opening into the gut.

As to the presence of Mr. Gosse's ". . . little granular body connected with the tip (of the foot) by a point, and enlarging at the upper end, where it is connected with a small globular vesicle," I have been unable to discover a single trace of its presence in section; and in my opinion it does not exist.

Mastax.

Melicerta ringens and *M. conifera.*

From the earliest days of microscopical investigation the mastax has, perhaps, of all the organs attracted the most attention. Originally taken for a heart, Prof. Ehrenberg clearly demonstrated its function in the early part of the present century. At a later period *M. ringens* formed the subject for a most detailed examination by Prof. Williamson, his paper being illustrated with some excellent figures. Mr.

P. H. Gosse (6) followed Prof. Williamson with a short paper on the same Rotifer in the same number of the same journal. A few years later he (Mr. Gosse (7)) published an elaborate treatise, furnished with numerous illustrations of the mastax, with the contained hard parts, in various species of Rotifers, this last work having since then formed the standard work of reference in connexion with this organ. In this last-named work Mr. Gosse, after giving a short summary of Prof. Williamson's investigations in connexion with the structure of the mastax, concludes as follows:—"He [Prof. Williamson] further states, that 'the conglobate organ in which the apparatus is imbedded [*i. e.* the mastax] is composed of numerous large cells, each of which contains a beautiful nucleus with its nucleolus.' . . . The statement of the cellular character of the mastax, and the presumption of penetrating muscles, are alike negatived by my observations, not only in this species, but in the whole range of the Rotifera. The able and learned Professor has probably been misled, in the former conclusion, by some overlying tissues, perhaps similar to the salivary glands in *Euchlanis*." With reference to the mastax, taken as a whole, Mr. Gosse says: "In substance it varies from a state in which its walls are thick and solid, composed of dense muscular fibre, with little cavity, as in *Brachionus*, to one in which it forms a capacious sac, with thin, apparently membranous, parietes, as in *Furcularia*. . . . In *Brachionus urceolaris* it (the mastax) is a dense, colourless, highly refractive mass of muscles. . . ."

Dr. Hudson makes remarks of a similar nature in his description of *Brachionus rubens*. He says: "Muscles, springing from the walls of the mastax, are attached to various parts of the mallei and rami, and act so as to cause the unci to approach and recede from each other."

A careful examination of serial sections taken through the mastax and the surrounding parts of *Brachionus rubens*, *Melicerta ringens*, *M. conifera*, and *Lacinularia socialis* has failed to reveal to me the slightest trace of the muscular investment described and figured by Mr. Gosse and other investigators.

Considering the crude methods employed by Prof. Williamson when he made his important discovery of the cellular character of the mastax, one can readily excuse the position in which he imagined these cells to be placed, for sections show these cells to be placed within the hard parts of the trophi, and not on the walls of the mastax. I have placed in my illustrations an almost complete series of drawings of sections taken through the anterior third of *Melicerta conifera*. I have

selected this species mainly on account of its size and also because of the ease with which one is able to study the sections. I have, however, deemed it prudent to include in my illustrations a nearly median transverse section through the mastax of *Melicerta ringens*. In this species (*M. ringens*) the cells in the hard parts of the trophi are perhaps better shown than in *M. conifera* (*vide* Pl. IV. fig. 4). Turning now to the movements of the mastax, Mr. Gosse notices his previous observations (6) and selects *Limnias ceratophylli* for a detailed examination. He says: "The mastax consists of three sub-globose lobes . . . one on each side appropriated to each malleus, and a third descending towards the ventral aspect, which envelopes the incus. The mallei are . . . intimately united to the rami of the incus . . . each uncus forming, with its ramus, a well-defined mass of muscle, enclosing the solid parts, and in form approaching the quadrature of a globe: two flat faces opposing and working on each other."

My own opinion is that there is only one pair of muscles present in the mastax. On reference to Pl. IV. fig. 3 it will be seen that each half of the manubrium is connected with its fellow by a comparatively thick arching band which stretches over the dorsal region of the mastax. Attached to this band on either side of the median line is a muscle, which I have figured slightly more prominently than it really is in section, which, running across each half of the ramus at an obtuse angle, terminates at the extremity of the fulcrum (*vide* fig. 3, *fm*). The movements of these various parts are as follows:—By the simultaneous contraction of the preceding muscles the rami are drawn upwards and inwards, and by the relaxation of the same muscles the rami are forced apart by the semi-circular band acting on them.

I may add finally that I have been unable to discover any muscular fibres penetrating the mastax.

Excretory System.

Flame-cells or Vibratile Tags.

Concerning the structure of these singular bodies there has been and still exists a considerable difference of opinion. A summary of our present knowledge concerning the structure of these bodies with their lateral canals is given by Dr. Hudson in his monograph, forming an appendix to the first volume. His description is too long for me to give at length; it may, however, be briefly summarized as follows:—

The structure of a flame-cell or vibratile tag is found to alter in appearance from whichever point it is observed.

Is there a single cilium within the tag, or are there minute cilia, as suggested by Dr. Moxon, "on each inner broad surface of the tag"?

"The next point," says Dr. Hudson, "is whether these tags are opened or closed at their free ends."

Mr. Jackson, in his edition of Rolleston's 'Forms of Animal Life,' says:—"They [the lateral canals] carry a number of ciliated organs, each of which consists of a pyriform canalicule, lodging at its free broad end a flame-cell. The canalicule is closed (Plate) or has a lateral aperture (Echestein)."

It seemed to me hopeless to attempt to arrive at any satisfactory conclusions concerning the structure of a flame-cell by employing the same means as hitherto employed; the attack to be successful must be made from another quarter.

Brachionus rubens is a very common Rotifer, and fortunately possesses flame-cells of considerable dimensions. After several failures I succeeded in preserving a gathering of these Rotifers in a fairly expanded condition, and also in cutting sections of them. In this species of Rotifer I find an individual flame-cell to consist of a hyaline cylinder, the extremity of which is rounded and closed, a single cell possessing a nucleus forming the distal termination. Springing from the centre of this cell and projecting forwards to almost the junction of the flame-cell with the lateral canal is a tapering broad-edged cilium, which has a free motion in the interior of the cell. The junction of the flame-cell with the lateral canal is marked by a fine granular deposit on the walls of the canal (*vide* Pl. V. fig. 14).

Lateral Canals.

The minute structure of these canals is a point to which but little attention appears to have been hitherto directed. The only reference which I can find relating to the minute structure of these canals is by Mr. Jackson. He says: "These tubes [lateral canals] have nucleated walls and are probably intracellular." The structure of these canals is most easily distinguishable in *Lacinularia socialis*. On reference to fig. 10 A, and the accompanying explanation, the walls of the lateral canals are seen to be lined with large cells, each cell being furnished with a distinct nucleus and nucleolus.

There is, however, one important portion of the lateral

canals in *Lacinularia socialis* to which I think sufficient attention has not been hitherto directed. Placed within the ciliary wreath or corona, on either side of the oral aperture, is a dilated portion of the lateral canals. A continuation of the lateral canal extends over the mouth, and joins the corresponding dilatation on the other side. Concerning this dilated portion of the lateral canals Prof. Huxley (3) says in a footnote as follows:—"The only discrepancy of importance in Leydig's account is, firstly, that he considers what I have called the 'vacuolar thickening on each side of the pharyngeal mass,' and what Ehrenberg calls a nervous centre, to be formed by convolutions of the water-vessel itself . . . Leydig does not seem to have noticed the transverse anastomosing vessel over the pharynx."

After a careful study of my sections through these dilated portions of the lateral canals I believe their structure to be as follows:—On reference to Pl. V. fig. 11 and the explanation accompanying it the course of a lateral canal can be easily traced for some considerable distance in the dilated portion, and then suddenly terminates. As to whether or no there is a ciliated opening at the point where the canal abruptly terminates I am unable to satisfy myself. Be this as it may, the tube continues, and, uniting with the transverse branch, runs over the ganglion and unites with its fellow on the opposite side. The character of the tissue which surrounds these convoluted tubes appears to be of a spongy nature with scattered nuclei (*vide* figs. 11 and 12). As to whether or no actual secretion takes place in this region, I am unable at present to determine.

As to whether or no the lateral canals finally open into the cloaca or possess a separate opening to the exterior, investigators have concerning this point differed greatly in opinion. Prof. Huxley says: "There is no contractile sac opening into the cloaca as in other genera, but two very delicate vessels, about 1-4000th of an inch in diameter, clear and colourless, arise by a common origin upon the dorsal side of the intestine. Whether they open into this, or have a distinct external duct, I cannot say." Dr. Hudson, after giving a short summary of Prof. Huxley's remarks, says:—" . . . but Dr. Leydig says that the lateral canals start from a common branch opening into a contractile vesicle, which discharges itself into the cloaca: it will be seen that a similar doubt exists concerning the termination of the canals in *Conochilus volvox*, and further investigation is, I think, wanted to make the matter clear."

After examining many dozens of sections taken through

Lacinularia socialis, I at last succeeded in obtaining one series of sections that left no doubt on my own mind as to the final termination of the lateral canals. On reference to fig. 13 the thin membranous-like termination of the united lateral canals will at once be seen. The slightly dilated junction rapidly narrows and opens to the exterior immediately beneath the anal aperture (fig. 13, *e*). I think the extreme difficulty one experiences in viewing in a satisfactory manner the termination of these lateral canals is mainly owing to the extreme delicacy of the walls of the lateral canals in the region of the posterior third to their junction. This statement receives confirmation from the fact that the termination of the lateral canals in all my other sections has eluded my most careful scrutiny.

Literature referred to.

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(4) Leydig, F. "Zur Anatomie und Entwicklungsgeschichte der *Lacinularia socialis*," Zeitschr. f. wiss. Zool. iii. 1851.

(5) Williamson, W. C. "On the Anatomy of *Melicerta ringens*," Quart. Journ. Micr. Sci. vol. i. 1853.

(6) Gosse, P. H. "On the Structure, Functions, Habits, and Development of *Melicerta ringens*," Quart. Journ. Micr. Sci. vol. i. 1853.

(7) ——. "On the Structure, Functions, and Homologies of the Manducatory Organs in the Class Rotifera," Phil. Trans. 1855.

EXPLANATION OF THE PLATES.

List of Reference Letters.

l.c. Lateral canals.
o. Ovary.
s.g. Salivary glands.
S.R. Salivary receptacles.
a. Opening of salivary receptacles into pharynx.
g. Ganglia (brain).
m. Muscles.
m.c. Mucous cells.
ST., *st.* Stomach.
i. Intestine.
c. Cuticle.
gg. Gastric glands.
x. Opening of gastric glands into œsophagus.
œ. Œsophagus.
b.c. Body-cavity.
f.c. Flame-cell.

v.t. Vibratile tag.
m.s.c. Marginal sense-cells of corona.
c.l.c. Coiled portions of lateral canals in the corona.
s. Spindle-shaped cells in foot.
mb. Manubrium.
fm. Fulcrum.
e. External opening of united portions of lateral canals.
d. United terminations of lateral canals.
z. Cells of unknown significance placed between stomach and intestine.
ph. Pharynx.

Plate IV.

Fig. 1. Transverse section of *Melicerta conifera* immediately beneath the base of the corona. Zeiss obj. E, oc. 3.
Fig. 2. Next section of same Rotifer, showing brain and salivary receptacles. Zeiss obj. F, oc. 3.
Fig. 3. Next section but one of same Rotifer, showing mastax and surrounding parts. Zeiss obj. E, oc. 3.
Fig. 4. Transverse section through mastax and surrounding parts of *Melicerta ringens.* Zeiss E, oc. 3.
Fig. 5. Transverse section through œsophagus and surrounding parts of *Melicerta conifera,* showing opening of gastric gland into the œsophagus. Zeiss obj. F, oc. 3.
Fig. 6. Transverse section through the middle of body of same Rotifer. Zeiss F, oc. 3.
Fig. 7. Transverse section of same Rotifer immediately beneath the junction of foot with body. Zeiss F, oc. 3.
Fig. 8. Vertical section through *Melicerta ringens,* showing cells of unknown significance placed between stomach and intestine. Zeiss E, oc. 3.

Plate V.

Fig. 9. Transverse section of *Lacinularia socialis* immediately beneath the junction of foot with body. Zeiss F, oc. 3.
Fig. 10 A. Vertical section through lateral canal of *Lacinularia socialis.* Zeiss F, oc. 3.
Fig. 10 B. Transverse section of *Lacinularia socialis,* showing gastric glands and one duct passing into the œsophagus. Zeiss E, oc. 3.
Fig. 11. Vertical section through margin of corona and surrounding parts of *Lacinularia socialis,* showing marginal sense-cell and coiled portion of lateral canal in the corona. Zeiss F, oc. 3.
Fig. 12. Transverse section through corona of *Lacinularia socialis,* showing brain and nerve-fibres terminating in marginal sense-cells. Zeiss F, oc. 3.
Fig. 13. Transverse section through same Rotifer, showing intestine with its external aperture and external opening of united portion of lateral canals. Zeiss E, oc. 3.
Fig. 14. Vertical section through *Brachionus rubens,* showing flame-cell with portion of lateral canal. Zeiss K, oc. 3.

IV.—*On Chilostomatous Characters in* Melicertitidæ *and other Fossil Bryozoa.* By Arthur Wm. Waters.

[Plate VI.]

I have on various occasions * pointed out that the Melicertitidæ have avicularia, and have also written to several friends who were at work upon the Chalk fossils with the hope that the relationship of this group would be thoroughly worked out. Mr. Vine, however, in his recent 'British Association Report,' and Dr. Pergens, in his revision of d'Orbigny's 'Cretaceous Bryozoa,' place them with the Cyclostomata without indicating any doubt as to the position; and it may therefore be well to again call attention to some of the characters of the group.

When d'Orbigny wrote, "cellules accessoires" was a convenient term, as but little was known about avicularia; and in this family they are sometimes called "cellules accessoires," sometimes "cellules ovariennes;" but it must be borne in mind that also in *Onychocella* and its allies d'Orbigny did not understand the function of the vicarious avicularia, which he called "cellules accessoires," and speculated that since they occur on the same zoaria as ovicells this could not be their function, but might they be male cells? Pergens, Marsson †, and others, however, follow, and speak of triangular ovicells. It is surprising that d'Orbigny should have called the organs figured on plate 736. fig. 6, and plate 735. fig. 15, 'Paléontologie Français,' ovicells, as they are so decidedly avicularian in shape; but as this is perhaps even more marked in a specimen of *Melicertites semiclausa*, d'Orb., in my collection, from Le Mans figures (1 and 8) are given. The presence of a spatulate mandible is distinctly indicated, and there can be little doubt that we have before us a vicarious avicularium. In some cases the end of the mandible has been unsymmetrical (fig. 8), similar abnormalities not being unfrequent in recent vicarious avicularia.

In *M. royana*, W. (fig. 2), there are also avicularia scattered over the surface, and here again, if we are to judge by analogy, we can scarcely doubt that in the beak there has been a chitinous mandible. The opening of the avicularium

* Quart. Journ. Geol. Soc. vol. xl. p. 679; &c.

† Marsson ('Die Bryozoen der weissen Schreibkreide der Insel Rügen,' p. 47) makes *Nodelea* a genus of the family Eleidea, based simply upon its having a special ovicell; but his figure of *Nodelea propinqua*, Mars., shows an undoubted avicularium and no ovicell.

differs somewhat from any with which I am acquainted, but nevertheless reminds us of avicularia and not at all of ovicells.

In *M. cenomana*, d'Orb., there are some large broken-down cells which I should be inclined to consider avicularian; but as the preservation of the specimen is unsatisfactory, this must remain uncertain. There is in another part an inflation round which the zoœcia are irregularly grouped; above the lower central zoœcium there is a semicircular depression with a few perforations, giving it the appearance of an "area" like those found in the ovicells of so many *Celleporæ* &c. I hope that this may receive further investigation from some one possessing better specimens.

Finding a character so distinctly Chilostomatous as avicularia, it is necessary to examine more carefully the others; and first, as to those on the surface, the front is punctate, with larger pores than those of the Cyclostomata. These have been overlooked, as the fossilization of Cretaceous forms makes it often impossible and usually very difficult to distinguish such surface-markings; but in sections they are readily seen. In figure 2 they are shown all over the surface, though, as a matter of fact, they can only be distinguished in a few zoœcia.

Over the aperture of some zoœcia there is a thin calcareous plate, but in others there is at a lower level a very peculiar partial closure, formed by three, or sometimes four, calcareous growths, starting from the side and uniting in the centre.

We thus find externally points which indicate that we are not dealing with a simple Cyclostomata, and examination of the interior structure is quite as convincing on this point. In transverse sections (figs. 5 and 11) a contraction formed by a curved plate is seen on each side just below the opening. Possibly an operculum has an attachment here, but of this I have not been able to satisfy myself. In longitudinal sections (fig. 4) there is also a projecting plate just behind the front wall; and although I am not acquainted with exactly similar contractions in any Chilostomata, they seem to indicate Chilostomatous affinities, and nothing of the kind is known in the simple tubular Cyclostomata. The central portion of the zoarium, however, consists of parallel plain tubes, and certainly this portion resembles the structure of many Cyclostomata. The lateral walls of the zoœcia in the wider part and also at the commencement of the tubular portion show the beaded structure * which I have described in *Heteropora*

* "On the Occurrence of Recent *Heteropora*," Journ. Roy. Micr. Soc. vol. ii. p. 390.

and other species of Cyclostomata, caused by the walls being thinner where the perforations occur.

Dr. Hann* placed the Melicertitidæ as a third "typus" (the Stigmatoporina) of the Inarticulata, a "tribus" of the Cyclostomata, on account of the mode of growth, namely the zoœcia terminating at right angles to a central bundle of long parallel tubes. Marsson† divides the Cyclostomata into typus Solenoporina and typus Metopoporina, the last including the families Ceidea, d'Orb., and Eleidea, d'Orb. Pergens ‡ makes a typus Melicertitina. Each of these workers calls attention to the trumpet-like dilation of the extremity of the zoœcia, but all speak of the triangular ovicell, though if we are to be guided at all by analogy there is no reason for speaking of an ovicell, whereas the resemblance to many undoubted vicarious avicularia is most striking, for there is evidently the platform for a triangular or spatulate chitinous appendage.

Before we can be sure of the position of this division, or perhaps suborder, the whole group must be reexamined, as probably some of the forms placed here by d'Orbigny should simply be removed to Chilostomata, others remaining with the Cyclostomata, leaving a division which should be carefully compared with some of the older forms, and perhaps some Palæozoic fossils will be elucidated thereby.

To come to the second part of the paper, E. O. Ulrich § has recently published an important work on the Palæozoic Bryozoa of Illinois, and considers that the suborder Cryptostomata of Vine shows relationship with the Chilostomata; and this publication has induced me to put together the above results, which, like many other fresh facts, have been among my notes for many years. Ulrich lays great stress upon two projecting processes in the interior of the Cryptostomata, which I pointed out as existing in a species of Fenestellidæ || and which Ulrich now calls hemisepta. These are usually at the base of what Vine and Ulrich call a vestibule; that is to say, there is within the shell a tubular shaft up to the external opening, so that it is at right angles to the "primary chamber," which might be called the zoœcial chamber. No explanation is attempted of the function of the hemisepta; but there are a great many recent species in which there is a similar vestibule, at the base of which is the oral aperture

* 'Die Bryozoen des Mastrichter Ober Senon.'

† 'Die Bryozoen der weissen Schreibkreide der Insel Rügen,' p. 7.

‡ "Revision des Bryozoaires du Crétacé figurés par d'Orbigny," Bull. Soc. Belge de Géol. vol. iii.

§ "Palæozoic Bryozoa," Palæontology of Illinois, vol. viii., 1890.

|| "Remarks on some Fenestellidæ," Manchester Geol. Soc. vol. xiv., 1878.

closed by an operculum, and all above this is the equivalent of the peristome. In recent forms a better name is required, so that it can be applied whether there is a projection above the zoarium or not.

This vestibule may be well seen in my figure* of *Adeonella atlantica*, B., which should be compared with some of Ulrich's. It also occurs in *Porina* and very well marked in *Schizoporella challengeria*, Waters†; other numerous instances could be given of the same thing in recent and fossil species. At the oral aperture there is often a small calcareous projection for the attachment of the operculum, which in *Schizoporella challengeria*, W., is so distinct that it may well be called a hemiseptum; and a similar projection is figured in *Bifaxaria denticulata*, B.‡

Many of Ulrich's figures remind us very closely of the structure in recent forms; but there are also several with a series of hemisepta, and it is very difficult to understand what these may mean, so that we may withhold judgment as to whether all that are grouped under Cryptostomata will prove to form a suborder. On the other hand, there seems good reason for thinking that a large number of Palæozoic forms previously placed with Cyclostomata really show greater affinities with Chilostomata.

Since Mr. Ulrich's paper was written I have recorded the fact that in Chilostomata there may be a closure exactly resembling that known in several Cyclostomata, and that it may exist above the oral (opercular) aperture§. Closures are known in many of the Palæozoic fossils; but these Mr. Ulrich calls opercula, a use of the term against which I must strongly protest, as "opercula" should only mean the movable chitinous cover as known in the Chilostomata. These closures seemed formerly to indicate relationship with the Cyclostomata, but now, knowing them in the other suborder, their presence cannot be considered to weigh against Mr. Ulrich's views.

Melicertites royana, sp. n.
(Pl. VI. figs. 2, 4, 5, 6, 11.)

D'Orbigny described *Multinodelea tuberosa* from several localities in the French Senonian, and among others from

* Supp. Chall. Rep. pl. ii. fig. 20.
† *Loc. cit.* pl. ii. fig. 25.
‡ *Loc. cit.* pl. ii. fig. 31.
§ "North Italian Bryozoa," Quart. Journ. Geol. Soc. vol. xlvii. p. 5 &c., pl. iii. fig. 4.

Royan, near Bordeaux ; but it would seem that he had more than one species before him, as the avicularia figured are not all the same. Those, however, that I collected in Royan have an avicularium differing from any figured by d'Orbigny, and therefore it seems necessary to describe it as a new species for the purpose of identification.

The avicularia sometimes occur in transverse rows, at other times irregularly distributed. The proximal portion of the avicularium has a plate, which is but slightly depressed; the distal end is much more depressed, with an opening at the lower part and a median slit; the end of the beak is raised. The closures referred to seem to be constant in shape, starting from the base and two sides, joining in the middle; but sometimes they start from four points. The contraction below the aperture is described on page 49.

A genus *Multinodelea* was created by d'Orbigny for a form consisting of more than one layer; but I found many specimens, some with and some without superimposed layers, and quite agree with Pergens that *Elea* and *Nodelea* must be placed in one genus. One section shows four superimposed layers, and it is very curious to see how these layers grow, for here (see fig. 4) the aperture is closed by a plate, and from this one wall of the tube forming the fresh zoœcium grows. As to the meaning of this extraordinary origin of the new zoœcia I would not attempt an explanation.

Melicertites semiclausa, d'Orb.
(Pl. VI. figs. 1 and 8.)

Melicertites semiclausa, d'Orb., Pal. Fr. p. 619, pl. 618. figs. 6–10, pl. 736. fig. 16.

This species was described by d'Orbigny from Le Mans as having no "cellules accessoires;" and if he had seen the avicularia it would have been placed with *Nodelea*, showing how artificial the division was. In my specimen from Le Mans the beak of the avicularium is large and expanded at the end, sometimes unsymmetrically so. The front wall of the zoœcia has large pores.

Although calling attention to various points of structure, I am not able to fix the limits of the Melicertitidæ; nor is the object of the communication to pronounce an opinion as to whether all the fossils described by Mr. Ulrich are Bryozoa, or whether some of the forms may not have to be removed from or to Cryptostomata; but there can be no doubt that

Mr. Ulrich, by giving figures of so many sections and pointing out fresh and important characters, has done work which will lead to a juster appreciation of the position of Palæozoic Bryozoa. I would urge the importance of a thorough comparison of Palæozoic with Cretaceous genera, for the number of known Cretaceous genera is very large, and with these and the present fauna comparison can be made, thus giving the best stepping-stone between the rich Carboniferous fauna and the recent.

I would like to ask why *Streblotrypa Nicklesi*, Ulrich, pl. lxxi. fig. 9, should be separated from *Petalopora* *, and there are other genera which do not seem altogether new. Should not *Worthenopora* be *Micropora*?

In conclusion, in the Cretaceous Melicertitidæ the characters are in the main Chilostomatous united with some that are Cyclostomatous, and also in a very large section of Palæozoic fossils there are important structures similar to those in recent Chilostomata.

EXPLANATION OF PLATE VI.

Fig. 1. *Melicertites semiclausa*, d'Orb. From Le Mans. Magnified 25 times.
Fig. 2. *Melicertites royana*, sp. n. Mag. 25 times.
Fig. 3. *Melicertites cenomana*, d'Orb. From Le Mans. Mag. 25 times.
Fig. 4. *Melicertites royana*, sp. n. Longitudinal section. Mag. 25 times.
Fig. 5. The same. Transverse section. Mag. 25 times.
Fig. 6. The same. Tangential section. Mag. 25 times. The upper portion is cut through nearer the surface than is the case in the lower part.
Fig. 7. (*Escharella argus*, d'Orb.) Mag. 25 times. From Maestricht. Showing a vicarious avicularium with an opening somewhat different from any yet described.
Fig. 8. Avicularium of *Melicertites semiclausa*, d'Orb. Mag. 25 times.
Fig. 9. (*Nodelea transversa*, d'Orb.) Avicularium copied from d'Orbigny, Pal. Fr. pl. 736. fig. 6.
Fig. 10. (*Nodelea ornata*, d'Orb.) Avicularium copied from d'Orbigny, *loc. cit.* pl. 735. fig. 14.
Fig. 11. *Melicertites royana*, sp. n. Transverse section. Mag. 50 times.

V.—*New* Scarabæidæ *in the British Museum: a Fifth Contribution.* By CHARLES O. WATERHOUSE.

[Concluded from vol. vii. p. 522.]

LITOCOPRIS, gen. nov.

I propose this name for a certain number of small species of *Copris* which differ from the ordinary forms in being more regularly oval; the clypeus is broadly and not deeply

* *Cavea*, d'Orb.

emarginate, but is not bidentate; the forehead has a slight swelling in the middle but no horn; the anterior tibiæ have the anterior margin of the apical tooth nearly at right angles to the axis of the tibia, and in the female the tibia is truncate at right angles; thorax evenly convex.

Litocopris punctiventris, sp. n.

Oblongo-ovalis, modice convexus, piceus, nitidus; capite sat crebre evidenter punctato, clypeo margine fere lævi; thorace æquali, sat crebre punctato, lateribus leviter arcuatis, basi impresso-marginato, linea punctata mediana abbreviata; elytris fortiter striatis, striis creberrime fortiter crenato-punctatis, interstitiis leviter convexis sat crebre sat fortiter punctatis, interstitiis 1°–4^{m} dimidio basali lævibus; corpore subtus femoribusque omnino crebre sat fortiter punctato, metasterno linea mediana lævi.
Long. 5 lin.

Hab. Senegambia, Lusitanica.

The head has the punctuation moderately finely but very distinctly punctured, the vertex is flattened, and here the punctures are very close together, but not crowded; the forehead has a trace of a tubercle in the middle. The thorax has a punctured impressed median line extending to the middle, and the surface on each side of this is smooth, in front of it the punctures are rather fine and not very close together and the middle of the front margin is nearly smooth; on each side of the disk the punctures are moderately strong and separated from each other by about the diameter of a puncture, or in places by two diameters; at the sides the punctures are coarser and crowded, and there is no smooth spot outside the usual lateral fovea. The elytra have the punctuation very distinct, the punctures separated by about one and a half or two puncture-diameters; at the sides the punctuation is rather closer, the second, third, fourth, and fifth interstices have a few fine punctures at the base, the sixth is smooth at the extreme base, the fifth has a smooth spot near the base. The whole of the underside is densely and rather strongly punctured, as well as the pygidium and femora; the punctures at the sides of the metasternum are coarse.

Copris mutica, Bohem.—According to a typical specimen sent to me from Stockholm by Prof. Aurivillius this is congeneric with the above, but is rather more broadly ovate; the elytra are not quite so deeply striated, the interstices less convex, and the punctuation quite different. The meta-

sternum has the space between the coxæ very distinctly punctured in front and on the sides close to the coxæ.

Copris simplex, Harold (Col. Heft. iv. p. 81).—If I have rightly identified this species it is closely allied to *C. mutica* and is a *Litocopris* with extremely finely punctured interstices to the elytra, but with deep striæ, as in *L. punctiventris*, and with the metasternum entirely smooth between the coxæ.

Dendropemon telephus, sp. n.

Oblongus, niger, nitidus, depressus; capite rugoso, antice bidentato, vertice carina obtusa recta postice obsolete punctulata, prope angulos posticos carina sat elevata; thorace modice convexo, basi lævi, medio subtilissime parce punctulato, antice distinctius punctulato, prope marginem anticum linea elevata, medio tuberculo parvo obtuso instructo; elytris fere quadratis, fortiter striatis, striis sat obscure punctatis, interstitiis leviter convexis, parce subtilissime punctulatis; pygidio obsolete punctulato; tarsorum posticorum articulo basali elongato fere parallelo, articulo secundo quintuplo breviori.

Long. $6\frac{1}{3}$ lin.

Hab. Cayenne.

This is one of the comparatively narrow species, somewhat resembling *D. viridis* in form, but rather more convex. The head is coarsely rugose in front, with the two rather obtuse teeth separated by an equilateral-triangular space; the space behind the frontal ridge is finely and vaguely punctured; the side-piece is divided into two nearly equal portions by a very distinct ridge, which does not quite extend to the eye; the front portion is finely punctured near the margin, the posterior portion is impunctate. The thorax has the median line and the two basal punctures well marked; the middle of the disk and the base are impunctate, the sides of the disk are very delicately and moderately closely punctured, the punctures becoming much more distinct in front; close to the front margin there is a small somewhat round protuberance, with a fine, nearly straight, raised line on each side of it. The elytra have the striæ deep, but sharply cut, nearly as in *D. viridis*; so that the interstices are only moderately convex. The posterior tarsi have the basal joint a little more than twice as long as broad, subparallel, a little narrowed at the base; the second joint very small, about one fifth the length of the preceding.

Dendropemon refulgens, sp. n.

Statura fere *Phanæi tridenti* ♀, cupreo-fulgens: capite rugoso, antice nigro-marginato, bidentato, vertice carina paullo elevata postice subtiliter punctulata; thorace lato, ante medium oblique paullo angustato, postice late sinuato, rugoso, disco postice sat fortiter minus crebre punctato, linea mediana sat impressa, basi punctis duobus obtusis distinctis, prope marginem anticum medio tuberculo parvo acuto utrinque leviter impresso et linea flexuosa instructo; elytris thorace angustioribus, apicem versus paullo angustatis, fortiter obtuse striatis, interstitiis bene convexis subtilissime parce punctulatis; pygidio subtiliter obscure punctato; tarsis posticis articulo basali elongato, subparallelo, secundo minuto, tertio minutissimo; corpore subtus obscure cupreo nigrotincto, pedibus fere nigris.

Long. $8\frac{1}{2}$, lat. 5 lin.

Hab. Cayenne.

This species is quite unlike all the other species of the genus known to me, and more resembles a *Phanæus*. It is of a brilliant coppery colour, but in some lights has bright green reflexions. The elytra have the striæ deep and rather broad, impunctate, and of a brassy tint in some lights; the interstices are almost smooth, except towards the sides, where they are more distinctly punctured. The posterior tarsi have the basal joint a little more than twice as long as broad, subparallel; the second joint is very small, about one fifth the length of the preceding; and there is a minute point representing a third joint.

Dendropemon smaragdinus, sp. n.

Oblongus, sat depressus, obscure viridis, nitidus; capite rugoso, antice bidentato, vertice carina sat acuta fere recta; thorace dorsim depresso, disco subtilissime punctulato, lateribus crebre sat fortiter punctatis, prope marginem anticum linea elevata medio tuberculo parvo sat acuto; elytris fere quadratis, parallelis, depressis, fortiter striatis, interstitiis perparum convexis punctis minutis hic et illic sparsis, interstitio laterali crebrius distincte punctato; pygidio obscure punctato; corpore subtus pedibusque fere nigris; tarsorum posticorum articulo basali latitudine vix duplo longiori, parallelo, basi solum modice angustato, ad apicem emarginato, articulo secundo angusto, brevi.

Long. $3\frac{1}{3}$ lin.

Hab. Bahia.

The head is rugose, except behind the frontal ridge, where its punctuation is rather fine but obscure; the two teeth in front are separated by a nearly equilateral-triangular space,

and there is a slight sinuosity in the margin on each side; the frontal carina is nearly straight, but has its middle and angles very slightly raised. The thorax has the median line strongly marked and reaching beyond the middle; the impressions at the base are transverse and not conspicuous; the punctuation is very fine and moderately close on the disk, much stronger at the sides; the fine ridge at the anterior border is slightly oblique on each side, with a small, rather acute tubercle in the middle. The posterior tarsi have the basal joint scarcely twice as long as broad, strongly emarginate at the apex; the second joint narrow, a little thickened before the middle, about half the length of the basal joint.

Dendropemon angustipennis, Harold.

Elongato-oblongus, sat depressus, cuprescens, subtus niger, nitidus: capite rugoso, antice nigro, bidentato, vertice obtuse carinato; thorace antice nigro, evidenter punctato, postice subtilius punctulato; elytris parallelis, latitudine paullo longioribus, fortiter striatis, interstitiis modice convexis, punctis minutis sparsis; pygidio punctato; tarsorum posticorum articulo basali parallelo, basi solum angustato, apice emarginato, articulo secundo angusto, quam articulo basali vix breviori.

Long. $4\frac{2}{3}$ lin.

Var. Omnino cyaneo-niger.

Long. 4 lin.

Hab. Amazons, Ega (*H. W. Bates, Esq.*).

This is one of the more elongate species and only slightly depressed. The head is black in front, partly coppery and partly green posteriorly; the frontal ridge is very gently curved, obscurely punctured posteriorly; the two anterior teeth are separated by a nearly equilateral-triangular space, and their outer edge forms with the margin an angle a little less than a right angle. The thorax has its sides parallel at the middle; the front portion is black, the black extending more at the sides; the median line is strongly marked, extending beyond the middle; the basal impressions are very small and inconspicuous; the anterior ridge is somewhat oblique on each side, obtusely angulated forwards in the middle, but with scarcely any tubercle. The elytra are a trifle longer than broad, obscure coppery, with slight green reflexions; the striæ deep, not very distinctly punctured, the interstices moderately convex and almost smooth. The posterior legs are short and thick; the basal joint of the posterior tarsi about one third longer than broad; the second joint scarcely shorter than the first, but much narrower, sub-

parallel; a third joint appears to be indicated by a minute point.

I can detect nothing to separate the smaller black specimen from the larger one described. Harold's description is very imperfect; but I think there is little doubt that the Museum examples are referable to his species, which is a nearly black variety with the suture of the elytra tinted with green.

Dendropemon lobatus, sp. n.

Oblongus, sat depressus, cyaneus, nitidus; capite rugoso, vertice carina brevi bene elevata, margine antico bidentato; thorace postice subtiliter punctulato, antice crebre sat fortiter punctato, prope marginem anticum linea elevata, medio lobo subquadrato utrinque antice sat excavato; elytris latitudine paullo brevioribus, ad latera leviter arcuatis, fortiter striatis, interstitiis bene convexis punctis minutis sparsis; pygidio viridi, crebre punctulato; tarsorum posticorum articulo basali elongato, fere parallelo basi solum sat angustato, ad apicem emarginato, articulo secundo angustiori, quam articulo basali paullo breviori.

Long. 5 lin.

Hab. Brazil.

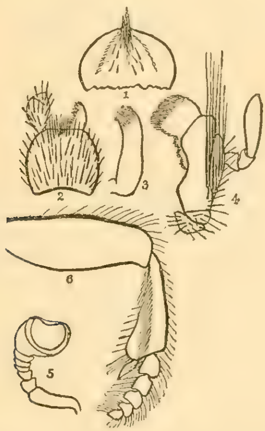
Obscure blue, with green reflexions, the thorax darker steel-blue. The head has the two teeth in front moderately separated, the space separating them rounded at the bottom, the margin with a small emargination on the outside of each tooth; the frontal carina is a little broader than high, with its apex arcuate, smooth in front and behind; the side-piece is divided into two unequal portions by an obtuse ridge parallel to the posterior margin. The thorax has its sides nearly parallel at their middle; the median line is strongly marked and extends beyond the middle; the basal impressions are distinct; the punctures on the posterior part of the disk are very fine and moderately separated, gradually becoming more distinct towards the sides, and in front they are moderately strong; the anterior ridge is very distinct, considerably sinuate on each side of the median projection, which has its angles very slightly raised. The posterior tarsi have the basal joint twice as long as broad, narrowed at its base; the second joint much narrower, subparallel, a little shorter than the basal joint; at the apex of the second joint there is a minute projecting point, which appears to indicate the third joint.

The female, which I have seen in Mr. Nevinson's collection, differs from the male in having the frontal ridge wider and much less elevated, and the ridge on the front of the

thorax is simply angulated forwards in the middle, without any distinct tubercle and without the smooth impressions in front.

MEGATHARSIS, gen. nov.

General characters of *Bolbites*. Mandibles very delicate, fringed with hair at the apex. Maxillary palpi with the apical joint very long, slightly fusiform. Mentum not emarginate at the apex. Labial palpi with the first joint rather thick and pear-shaped; the apical joints are wanting (? owing to accident). Antennæ nine-jointed, the first joint of the



1. Labrum. 2. Labium with one palpus removed. 3. Mandible. 4. Maxilla. 5. Antenna. 6. Hind leg.

club excavated so as to receive the second and third joints. Head somewhat semicircular. Thorax transverse, with the sides emarginate behind the middle, fringed with hair at the sides and base. Scutellum invisible. Elytra short, with seven striæ. Under flanks of the pronotum without transverse carina. Prosternum with a minute acute tubercle in the middle of the front margin *. Metasternum as in *Phanæus*, but very flat, obliquely narrowed in front. The front tibiæ with four very oblique teeth (including the apical one); tarsi absent. Intermediate legs with the coxæ very widely separated, parallel; the tibiæ rather short, gradually and very much enlarged towards the apex, with two spurs, the longer

* Mr. Nevinson has just called my attention to this spine in certain *Phanæi*, or I should have overlooked it here.

one reaching to the fourth joint of the tarsi; tarsi broad, compressed, about three quarters the length of the tibiæ, the basal joint triangular, a little broader than long, claws absent. Posterior legs with the femora subparallel; the tibiæ moderately long, gradually but not very much widened towards the apex, the outer edge with an irregular series of small tubercles; the tarsi about two thirds the length of the tibia, fringed on both sides with long hair, flat, broad, the basal joint scarcely longer than broad, the third and fourth a trifle broader than long, irregular-ovate, claws absent. Abdomen very short, with fringes of dense hair beneath, with four acute tubercles on each side, projecting beyond the margin of the elytra.

This interesting genus may be placed next to *Bolbites*; but the structure of the hind legs and especially the tarsi is quite different.

Megatharsis Buckleyi, sp. n.

Rotundato-ovalis, convexus, æruginosus, subtus plus minusve nigro-tinctus, nitidus; capite antice nigro, crebre rugoso, fronte carina transversa carina medio tuberculo minuto instructa, vertice punctato; thorace crebre punctato et subruguloso, disco antice macula obscura nigra ornata, lateribus et basi fulvo fimbriatis; elytris sat opacis, leviter sat late striatis, striis basi profundioribus, interstitiis fere planis, subtiliter obsolete punctulatis, basi solum convexis et nigro-suffusis; pedibus piceis, æneo tinctis, subtus plus minusve æruginosis, longe fulvo fimbriatis; pygidio crebre punctato.

Long. $6\frac{1}{2}$ lin.

Hab. Ecuador, Chiquinda (*Buckley*).

The posterior femora have the rusty fringe of hair on the anterior margin only; the posterior tibiæ, besides the thin fringe on the outer and inner edge, have a fringe of dense hair on the upper surface, commencing at the inner angle of the base and extending to the middle of the apex.

Gomphas Lemoinei, sp. n.

Oblongo-ovalis, crassus, subopacus, obscure æneus passim cupreo-tinctus: capite ruguloso, antice nigricanti, medio cornu sat longo acuminato ad apicem truncato; thorace crebre granuloso, antice biimpresso, disco antice bicornuto; elytris distincte striatis, interstitiis leviter convexis.

Long. 10 lin.

Hab. Caracas, La Guayra.

This is very near *G. æruginosus*, Perty, but is more elongate; the horn on the head is longer and more acuminate; the thorax is less transverse, with the granulation stronger on the disk, leaving a fine smooth median line; the discoidal prominence is narrower. The elytra are less dull and have the striæ more distinct, with the interstices (especially the second and fourth) slightly convex. The metasternum is not so smooth, and the punctured space on each side of the front part is consequently less abruptly limited.

VI.—*Descriptions of new Genera and Species of* Pyralidæ *contained in the British-Museum Collection.* By W. Warren, M.A., F.E.S.

[Continued from vol. vii. p. 501.]

Hyperparachma, gen. nov.

Species of small size, under $\frac{3}{4}$ inch. Fore wing with costa abruptly arched at base, then slightly convex to apex, which is bluntly rounded; hind margin only slightly oblique; at the base of the costa is an oval space smooth-scaled above, followed at one third of costa by a thick erect tuft of scales; the underside of the basal flap is densely clothed with semierect scales, and the whole basal half of the wing is beset with hairs. Hind wing on underside with a long curved fringe of hairs along the upper margin of the cell; labial palpi obliquely porrect; the middle joint hairy, the terminal short, inclined forward; tongue present; maxillary palpi invisible; antennæ rather thick, especially towards the base, with sharply angulated joints above, pubescent beneath; head rough; ocelli absent.

Type *Pyralis bursarialis*, Wlk. xxxiv. p. 1231.

Hyperparachma rubrifusca, sp. n.

Fore wing ochreous, with a yellowish tinge, and dusted with reddish atoms; first line oblique from end of the basal flap to the inner margin at one third; second line from costa at two thirds runs at first a little obliquely outwards to the middle of the wing, then with an inward indentation to near the anal angle; the space between the two lines is entirely filled with dull reddish-brown atoms, diffusely placed, excepting a small semicircular yellowish space on the costa; the inner

margin at base and the costa before apex are also more yellowish; base of fringes brownish (fringes of fore wing gone). Hind wing pale ochreous, with greyish suffusion. Head, face, and thorax ochreous; abdomen more cinereous. Underside of both wings dusted with brick-red towards costa; hind wing yellowish; hairs of the basal flap and costal tuft purplish brown.

Expanse of wings 16 millim.

One female from S. Paolo.

Idioblasta, gen. nov.

Fore wing not elongate; costa faintly curved; apex rounded; hind margin hardly oblique, vertically curved. Hind wing rounded, with a very slight indentation below the apex; labial palpi porrected upwards, short; terminal joint indistinct; maxillary palpi erect, widened at top; tongue weak; ocelli present; antennæ laminated, basal joint enlarged; legs stout; ovipositor of female exserted, long, as in *Hypsopygia*.

Type *Idioblasta lacteata*, Warr.

Idioblasta lacteata, sp. n.

Fore wings very pale straw-colour, almost white, tinged with ochreous in places; a subbasal line black, running at first obliquely outwards to the subcostal, then vertically concave to the hind margin; on either side of the centre are two black lines, likewise vertical, concave inwardly, running parallel to each other, the intermediate space divided into three equal parts by two horizontal dark dashes connecting the two cross lines; hind margin narrowly fuscous, beyond a submarginal line composed of black wedge-shaped spots; a dark reniform stigma is more or less hidden by the top horizontal dash. Hind wing with a broadish blackish border, which fades off towards the inner margin; fringes straw-colour, as are the head, thorax, abdomen, and underside; tips of palpi darker; underside of fore wings with a broad black blotch across the wing at two thirds.

Expanse of wings 16 millim.

One female, two males, Marquesas Islands.

Idioblasta straminata, sp. n.

Fore wings yellowish buff; with two very indistinctly marked cross lines, the first, vertical, at one third, the second, outwardly curved, at two thirds, the first preceded and the

second followed by a faintly paler line; both are darker at the costa. Hind wing rather paler, with a broad blackish marginal band, which stops short halfway from apex. Head, thorax, and abdomen concolorous. Underside the same, but with the apical third almost wholly brown-black.

Expanse of wings 16 millim.

One male, Marquesas Islands.

EUPOCA, gen. nov.

Wings ample; fore wing with costa slightly arched, hind margin obliquely curved, showing a very slight bend in the middle; inner margin strongly fringed with hair-like scales, more or less erect, and forming stronger tufts at the ends of the basal and central fasciæ. Labial palpi erect, sloping slightly forward, with appressed scales; second joint long, third short, acuminate, reaching a little above the vertex; maxillary erect, short, slender; tongue spiral; ocelli present; antennæ laminated, pubescent beneath, rather thick; head hairy behind; scaling fine and thin, but overlaid towards the base with long hair-like scales. Male with slight anal tuft.

Type *E. cinerea*, Warr.

Eupoca acutalis, sp. n.

Fore wing more acutely pointed and narrower; hind margin much more oblique than in *E. cinerea*; costa straight, slightly convex only just before apex; inner margin only three fourths of costal; scaling iridescent; surface thickly dusted with a mixture of whitish and mouse-coloured scales; lines very indistinct; basal area not darker than ground-colour, bounded by a faintly darker line which runs from the inner margin parallel to the hind margin and is reflexed just below the costa; the ordinary first line, also parallel to the hind margin, forms the inner boundary of a slightly darker central space, and is similarly recurved below the costa, which it reaches about the middle; second line, starting from costa at three fourths, is first slightly curved outwards, and then runs parallel to the others and the hind margin to the inner margin some distance before the anal angle; a faint dark lunular dash at the end of the cell; fringes cinereous, with their extremities whitish. Hind wing pearly white, with a very faint indication of a subcentral band, the base of the fringes and a central fringe-line fuscous. Head and thorax concolorous with fore wings, abdomen with hind wings.

Expanse of wings 13 millim.

One female, one male, from Callao, the former rather worn. The projecting scales on the inner margin of fore wing are not so prominent as in *cinerea.*

Eupoca cinerea, sp. n.

Fore wing cinereous ochreous, with the basal patch and a central fascia, which is twice as broad on costa as on inner margin, dark fuscous; basal patch overlaid by a bed of partially raised black and grey hair-like scales; central fascia dark fuscous, with a paler curved inner edge, and the outer edge, also paler, formed by the second transverse line, which, at first running straight from the costa, makes in the middle a large curve, and then runs in and reaches the inner margin not far from the inner edge; the discocellular is indicated by a dark lunule, each end of which is marked by a darker dot; the costal portion of the central fascia is dusted with greyish scales; a series of dark marginal dots. Hind wing whitish ochreous, semitransparent, with a series of dark blotches along hind margin; inner half of wing beset with long hairs, which on the abdominal margin are blackish. Fringe of fore wing cinereous, of hind wing straw-colour dashed with fuscous; head, thorax, and abdomen dark cinereous; anal tuft ochreous; underside glossy greyish ochreous, with the markings faint.

Expanse of wings 22 millim.

Four males from S. Paolo and Callao.

DYSPYRALIS, gen. nov.

Fore wing with the costa gradually convex; apex blunt; hind margin obliquely curved. Hind wing rounded. Labial palpi upcurved in front of face; second joint with thick projecting scales in front, laterally flattened; terminal joint aciculate; tongue, maxillary palpi, and ocelli absent; face flat; antennæ with distinct angulated joints; pubescent beneath.

Type *Dyspyralis illocata*, Warr.

Dyspyralis illocata, sp. n.

Fore wing whitish grey, the costa at base blackish; a broad, irregularly bounded, blackish band just before the middle; apical region more suffused with dark, especially towards the costa, which before the apex has five or six small white dashes; a series of subcontiguous black dashes at base of fringes, which are cinereous. Hind wing greyish fuscous.

Head, face, and palpi blackish; abdomen grey. Underside whitish grey, with an ochreous suffusion.

Expanse of wings 16 millim.

One male, without locality, in the Zeller collection.

Dicymolomia, Zell.

Type *Cataclysta julianalis*, Wlk. xvii. p. 438.

Dicymolomia diminutalis, sp. n.

Fore wing bone-colour, irregularly suffused with pale tawny and steely grey; basal area dusted with very fine blackish atoms; bounded by an indeterminate brown shade, representing the first line, which runs obliquely from near the base of the inner margin to a dark spot in the middle of the costa; second line, a broadish shade, starts from the costa at three fourths, forms first an outward curve, and then disappears; space between the lines finely dusted with steel-grey in the costal half, but suffused with pale tawny ochreous and grey towards the inner margin; submarginal area darker grey, becoming tawny towards the costa; fringe with two very fine dark lines, and a similar line parallel and preceding the basal line. Hind wing with the costal half whitish, becoming gradually darker cinereous; four black white-faced dots along hind margin; a faint, pale, curved subcentral band; tuft of hairs blackish; abdominal margin and fringe whitish. Head and thorax grey and tawny mixed; abdomen grey at first, becoming more ochreous towards the anal segments.

Expanse of wings 12 millim.

One male from Callao, only about half as large as the two North-American species.

Micraglossa, gen. nov.

Fore wing shaped like *Scoparia*, and with apparently the same markings, but the scaling is more glossy and resembling that of *Aglossa*. Labial palpi upcurved in front of face; the second joint hairy, the third acuminate and rather long; maxillary palpi feathery, erect, just behind the labial, reaching to the top of their second joint; tongue short, but present; ocelli absent; antennæ moniliform (♀); head rough in front between the antennæ.

Type *M. scoparialis*, Warr.

Micraglossa scoparialis, sp. n.

Fore wing glossy whitish, finely freckled with darker; extreme base blackish, consisting of three blotches—one costal, one subcostal, the third on the inner margin; first line slightly curved, black, followed by a blackish blotch for two thirds from the costa, which embraces two stigmata, as in *Scoparia*; reniform stigma black, 8-shaped, oblique, with a blackish costal blotch above it; second line indistinct; hind-marginal area with the usual fuscous shades of *Scoparia*. Hind wing whitish ochreous, rather glossy. Second joint of labial palpi and basal joint of antennæ dark fuscous; head and thorax fuscous; abdomen whitish at base, gradually becoming greyer.

Expanse of wings 12 millim.

One female from Darjiling.

MICREREMITES, gen. nov.

Fore wings with costa nearly straight, apex bluntly rounded; hind margin obliquely curved, with a very decided indentation below apex, opposite the cell. Hind wings rounded, showing a faint trace of the same indentation; both wings narrow and elongate. Palpi sickle-shaped, very long; the second joint standing well out in front of head, hairy, the terminal upcurved and overtopping the head, slender and pointed; antennæ in male moniliform and pubescent, in female simply moniliform; tongue short.

Type *M. fatua*, Warr.

The genus is related to *Sufetula*, Wlk. (=*Pseudochoreutes*, Snell.), which has the same subapical indentation in the hind margin, but much shorter palpi.

Micreremites fatua, sp. n.

Fore wings dull bone-colour, with the costa at the base and the whole central area between the two transverse lines dark grey; the two lines at one third and two thirds undulating, dark grey, the first edged internally, the second externally, with paler, approaching one another below the median vein; a large brown-black cell-spot in the dark central space just before the second line; a sinuous subterminal line faintly paler; extreme apex and base of indentation dark grey. Hind wings like fore wings, rather greyer along the hind margin. Head, thorax, and abdomen bone-colour; centre of abdomen dark grey; underside straw-colour, with darker grey markings, the whole basal two thirds being blackish.

Expanse of wings 16 millim.

One male in the Zeller collection, without locality, but probably from Calcutta.

Micreremites rasalis, sp. n.

Fore wing pale whitish ochreous, rather glossy, almost without any markings; first line curved at about one fourth, second, rising on the middle of the costa, forms nearly a semicircle round the obscure reniform stigma, and then runs to the inner margin about the middle. Hind wing with the central dot and second line repeated; base of fringes in both wings slightly darker. Underside without markings. The subapical indentations in both wings are fainter than in *M. fatua.*

Expanse of wings 16 millim.

One female from Dharmsala.

LISSOPHANES, gen. nov.

Fore wing with straight costa, curved only a little at base; apex obtuse; hind margin straight, not very oblique. Hind wing rounded, scaling smooth; labial palpi porrect, drooping, short; roughly fringed beneath; terminal joint pointed; maxillary palpi small, erect; forehead rounded, rather prominent; tongue and ocelli, as far as can be seen, absent; antennæ crenulated, pubescent beneath; abdomen short, not exceeding hind wing.

Type *L. ceramica*, Warr.

Lissophanes ceramica, sp. n.

Fore wing pale cream-colour, suffused with dull pale olive and dusted in places with greyish atoms; a black dot at the middle of the base; a fine black line close to base, formed of three black dots, followed by a paler fascia, which gradually merges into olive and forms the edge of the basal patch, which is margined with blackish and distinctly angulated in the middle; followed by the cream-white first transverse line; second line cream-white, forms first a broad curve outward and then a small one above the inner margin; the central space is dull olive; the first line is followed and the second preceded by a darker costal spot; orbicular stigma black on the edge of the first line; reniform stigma black, with a white patch beyond it; space beyond second line olive, thickly dusted with cinereous, leaving two small whitish

patches, one subapical, the other above the anal angle; fringe olive-grey, spotted with white; basal line dark grey. Hind wing dull olive-grey, with a whitish, oval, dark-centred, ocelloid patch at the anal angle; fringes whitish, dotted with grey at their base. Face, palpi, and collar white; thorax olive; abdomen pale grey; antennæ blackish. Underside dull fuscous olive.

Expanse of wings 12 millim.

One female from Callao.

Tegulifera, Saalmüller.

Type *T. rubicaudalis*, Saalm. Ber. Senck. Ges. 1880, p. 305.

Tegulifera sanguinea, sp. n.

Fore wing: ground-colour pale dull ochreous-yellow, more or less dusted or suffused with reddish; the basal and marginal areas always red; the two transverse lines yellowish, the first slightly curved outwards in the middle, the second irregularly notched and jagged, the former with a reddish line beyond it, the latter before it; discal spot large, black; fringes pale shining yellowish. Hind wings with all the markings of the fore wings reproduced. The amount of reddish tinge is extremely variable; in some specimens there is hardly any, except of course in the basal and marginal areas, whereas in one example the whole surface of both wings with the fringes is saturated with red. Head, thorax, and abdomen vary similarly; as a rule they are mingled grey and reddish. Underside yellow, red towards the edges; the exterior line showing red on a yellow ground.

Five specimens from Madagascar.

Expanse of wings 12–16 millim.

Endotricha, Zell.

Type *Pyralis flammealis*, W. V.

Endotricha (?) *stenialis*, sp. n.

Wings dark fawn-colour, dusted with paler; a paler curved line near base; a pale lunule at the end of the cell and a pale darker-edged spot midway between them; a pale, slightly denticulated, submarginal line; costa with three pale, dark-edged, lunular marks. Hind wings showing only faint traces of a central and submarginal paler line; fringes all rather

darker than ground-colour. Head, thorax, and abdomen all fawn-coloured.

A slender species, with long legs, recalling *Stenia*.

Two females from Borneo, expanding 11 millim.

Endotricha flavifimbrialis, sp. n.

Fore wings rosy, tinged with yellow in the central area; first line pale, curved, nearer the base than usual; basal patch wholly rosy; exterior line close to hind margin, consisting of a series of very fine yellow undulations, curving outwards a little from the costa and ending in the anal angle; narrow space beyond it, like the base, wholly rosy; fringes bright yellow, with the apical point and a small central patch rosy and with a fine line of black along the base. The coloration of the central area varies; in one specimen it is rosy brown, with the under tint yellowish; in a second the whole is unsuffused yellow, with a single rosy patch externally; cell-spot distinctly dark; costa spotted irregularly with yellow from base to exterior line. Hind wings like fore wings, the central band, however, occupying only the middle third, and varying in colour with that of the fore wings; fringes wholly bright yellow, with a small rosy dot at end of each vein. Head, thorax, and abdomen mixed rosy and yellow. Underside like upper, but tinged with grey.

Two females, one male, the former from Dharmsala and Formosa, the male from Bombay.

Expanse of wings 22 millim.

It is in the male that the yellow tint of the central area prevails, while both females are there suffused with brownish red. Whether this difference holds in all cases remains to be proved. The species is akin to *sondaicalis*, Snell.; but in that the fringes are pale straw-colour, with the apex and central patch blackish.

Endotricha rufofimbrialis, sp. n.

Fore wings ochreous-yellow, gradually becoming vinous red towards the hind margin; first line at one third rather indistinct, exterior line shortly, but not immediately before the hind margin, slightly wavy, edged on both sides with darker; before it on the costa a decided yellow patch; cell-spot distinct, dark; fringes wholly vinous red, with the basal half chequered with darker. Hind wings wholly vinous red, except the central curved space, which is edged on both sides by a dark grey line and filled up with tawny yellow; fringes as in fore wings, wholly red. Head, thorax, and abdomen

ochreous yellow. Underside nearly wholly vinous red, mottled with dark grey, the yellow subapical costal patch of the fore wings only being represented.

Expanse of wings 18 millim.

One female from Borneo.

Endotricha flavifusalis, sp. n.

Fore wings bright pink, with a broad, pure yellow, central fascia, not separated from the pink by any definite lines; cell-spot small, dark; a faint wavy submarginal line just before the fringe; fringes entirely pink, except a short distance below the apex; costa with rather large yellow spots. Hind wings like fore wings, the yellow band broader and in the male running to the hind margin towards the inner angle. Underside like upper. Head, thorax, and abdomen pink, intermixed with yellow.

Expanse of wings 14 millim.

One male, one female, from Borneo.

VII.—*Revision of the Noctuid Moths in the Natural-History Museum hitherto referred to* Eriopus *and* Callopistria. By ARTHUR G. BUTLER, F.L.S., F.Z.S., &c.

[Plate IX.]

THE genus *Callopistria* was founded by Hübner, in his 'Verzeichniss bekannter Schmetterlinge,' for the reception of two species, *C. pteridis* and *C. juventina*, from Europe and Surinam respectively. In all probability *C. juventina* was only known to Hübner, as it certainly was to Walker, from Cramer's figure; and therefore *C. pteridis* (placed by both of these authors at the head of the genus) becomes the type of *Callopistria*.

Eriopus, Treitschke, adopted by M. Guenée for the same group and considered by Walker to be synonymous with it, had for its type *E. pteridis*, and therefore is, without question, synonymous with *Callopistria*.

In the 'Proceedings of the Zoological Society,' 1881, Mr. F. Moore founds two genera—*Methorasa* for the reception of *Eriopus Latreillei*, Dup., and *Cotanda* for *Eriopus placodoides*, Guen.

A careful examination of structural characters reveals the fact that the genus *Callopistria* as extended by Walker and

subsequent authors contains no less than nine genera, distinguished as follows:—

1. Primaries with rounded outer margin.

a. Antennæ in both sexes simple, tapering; legs strongly tufted.................................... *Methorasa.*

b. Antennæ of male strongly ciliated, with a well-defined almost central twist or kink; legs almost naked .... *Gnamptocera.*

2. Primaries with angulated outer margin.

a. Antennæ slightly pubescent in the males, rarely with a few extremely delicate cilia towards the base; very slender in the females.

aa. Palpi small and weak, a single dorsal tuft on the second abdominal segment; first and second pairs of legs thickly clothed with long hair scales; tibiæ of hind pair clothed with fine hair......................... *Haploolophus.*

ab. Palpi large, with well-exposed terminal article; dorsal tufts, as usual, on first and second abdominal segments; legs, but especially the tibiæ of second pair, more densely hairy and tufted than in the preceding genus; a flattened fringe of dusky hair on femora of hind pair .... *Dissolophus.*

ac. Palpi rather large, with exposed terminal article; dorsal tufts probably normal (imperfect in our specimens); all the legs, including the basal joint of the tarsus, densely hairy, the hind pair almost concealed by the long hairy clothing......................... *Hyperdasys.*

b. Antennæ slender, ciliated, and with the basal third to half abruptly thickened in the males; legs moderately hairy, the spur of the middle tibiæ fringed with long hair .... *Hemipachycera.*

c. Antennæ of males slender, the basal two fifths usually naked, rarely pilose, always thickened, and terminating in a sloping fringed swollen bend, beyond which there is a well-defined ciliation; legs thickly clothed with long hair .... *Callopistria.*

d. Antennæ of males much thicker, ciliated, the basal third to two fifths twice the thickness of the remainder, terminating in an enlarged acutely angular process, beyond which the ciliation is more pronounced; hairy clothing of legs very similar to that of *Hemipachycera.* *Cotanda.*

e. Antennæ of males with the basal two fifths thickened and strongly ciliated, especially at the thickest or distal portion, which is also serrated and emits a group of three long entangled clubbed hairs; femora of front and hind legs and all the tibiæ fringed with long dense hair .... *Rhoptrotrichia.*

The admirable drawings of the structural characters occurring in this group, prepared by my friend Mr. Frohawk, have not only confirmed my decision as to the generic distinction of many of the species formerly associated under one, or latterly under four, genera, but in one or two instances they have revealed to me differences which I had overlooked when comparing one species with another. All the drawings are taken from male examples, as the most trenchant distinctive characters are found in that sex.

Should the structural differences upon which these genera are based be considered insufficient on the ground that they are secondary sexual characters, consistency will demand that at least half the genera already characterized in the order Lepidoptera shall be set aside.

The following are in the British-Museum collection:—

METHORASA, Moore.

Type *Methorasa Latreillei*. (Pl. IX. fig. 2.)

Eriopus Latreillei, Duponchel, Lép. Eur., Suppl. iv. p. 327, pl. cxxiii. fig. 2.

Europe and India. Coll. B. M.

Methorasa argentilinea.

Callopistria argentilinea, Walker, Lep. Het. xii. p. 863. n. 6 (1857).

United States. Type Coll. B. M.

Methorasa cordata.

Bombyx cordata, Ljung, Kongl. Vetenskaps-Akad. Handl. p. 347, pl. ii. figs. D 1, D 2 (1825).

West Indies. *Hab.* —— ? Coll. B. M.

We had a specimen of this species without locality under *M. monetifera*; it differs from the latter chiefly in its much more rufous primaries and rufous-brown secondaries; the latter are described thus:—" posticis brunneis, immaculatis; margine pallido," the fringe being pale. All the specimens of *M. monetifera* which we possess have whitish secondaries suffused with bronzy greyish towards the outer margin; so that *M. cordata* is probably the West-Indian representative of *M. monetifera*. Should the latter prove to vary considerably in a large series so as to include the West-Indian form, the name *M. cordata* will have to supersede it.

Methorasa monetifera.

Eriopus monetifera, Guenée, Noct. ii. p. 294. n. 1098.

E. Florida, New York, &c. Coll. B. M.

The name *Herrichia*, which Grote proposed for the mixed assemblage under *Eriopus* of the United States, cannot be retained for any of the species, as it was used by Staudinger for a genus of Lepidoptera in 1870.

Herrich-Schäffer probably compared the New-World species with the type of *Callopistria*, and consequently came to the conclusion that they were more delicate than the European forms. *Haploolophus mollissimus* is so, but the others are no more slender in structure than *Methorasa Latreillei*. As regards his opinion that the American species are more nearly related to *Erastria* (*Eustrotia* of Grote's 'Check-list'), I hold that the Callopistriidæ are far more nearly related to that genus than to *Plusia*.

GNAMPTOCERA, Butler.

Type *Gnamptocera minuta*. (Pl. IX. figs. 1, 1 *a*.)

Callopistria minuta, Butler, Ill. Typ. Lep. Het. vii. p. 7, pl. cxxx. fig. 4 (1889).

Dharmsala. Type Coll. B. M.

Gnamptocera minor.

Callopistria minor, Hampson, Ill. Typ. Lep. Het. viii. p. 81, pl. clxvi. figs. 16, 17 (1891).

Nilgiris. Type Coll. B. M.

HAPLOOLOPHUS, Butler.

Type *Haploolophus mollissimus*. (Pl. IX. figs. 3, 3 *a*.)

Eriopus mollissima, Guenée, Noct. ii. p. 294. n. 1098.

East Florida, New York, &c. Type Coll. B. M.

DISSOLOPHUS, Butler.

Type *Dissolophus chloriza*.

Eriopus chloriza, Guenée, Noct. ii. p. 296. n. 1102.

Java. Type Coll. B. M.

Dissolophus aluensis, sp. n. (Pl. IX. fig. 4.)

♂. Nearest to *D. chloriza*, smaller; primaries golden argillaceous, with bands of a darker shade, the central belt more regular than usual, less constricted, with black-dotted darker edges bounded by silver lines, the discoidal markings represented by an oblique white omega; three black dots, bounded by a bisinuated white line, at base; a zigzag whitish submarginal streak from apex to near inner margin; a marginal series of black-dotted white spots; fringe tipped with silvery white and dotted with black: secondaries sericeous whity brown, greyish towards base, with a submarginal grey band; a dark grey discocellular crescent; two or three subapical black dots on outer margin; fringe tipped with silvery white: body golden argillaceous; collar with one or two black dots in the centre; abdomen darker than thorax. Primaries below greyish, the borders creamy white, a blackish diffused patch divided by the subcostal vein towards end of cell; a whitish-bordered transverse irregular line crossing the wing at external third; a black oblique diffused dash, interrupted by the usual pale costal dots, at apex; black dots on the fringe as above: secondaries creamy white; costal area irrorated with black scales; discocellulars and a denticulated line beyond the middle blackish; three or four black dots on outer margin: pectus cream-coloured; venter, legs, and outside of palpi ochraceous; the usual blackish tuft at base of hind legs.

Expanse of wings 23 millim.

Alu, Solomon Islands. Type Coll. B. M.

This is smaller than either of the other species of this genus.

Dissolophus repletus. (Pl. IX. fig. 5.)

Callopistria repleta, Walker, Cat. Lep. Het. xii. p. 865. n. 13 (1857).

North India, Dharmsala; Osaka, Japan. Type Coll. B. M.

HYPERDASYS, Butler.

Type *Hyperdasys exotica*. (Pl. IX. fig. 6.)

Callopistria exotica, Guenée, Noct. ii. p. 294. n. 1097.

Java. Type Coll. B. M.

Hyperdasys insularis.

Callopistria insularis, Butler, Ann. & Mag. Nat. Hist. (5) x. p. 230 (1882).

Duke-of-York Island, Alu, Solomon group. Type Coll. B. M.

HEMIPACHYCERA, Butler.

Type *Hemipachycera rivularis*. (Pl. IX. fig. 7.)

Callopistria rivularis, Walker, Lep. Het. xii. p. 867. n. 15 (1857).

North India, Dharmsala. Type Coll. B. M.

Hemipachycera Yerburii.

Callopistria Yerburii, Butler, Proc. Zool. Soc. 1884, p. 496.

Aden and Nilgiris. Type Coll. B. M.

Hemipachycera duplicans.

Callopistria duplicans, Walker, Lep. Het. xii. p. 866. n. 14 (1857).

Moulmein and Silhet. Type Coll. B. M.

CALLOPISTRIA, Hübner.

Type *Callopistria purpureofasciata*. (Pl. IX. figs. 9, 9 *a*.)

Noctua purpureofasciata, Piller, Reise durch Posega, pl. vi. fig. 2 (1783), =*pteridis*, Fabr.

Europe. Coll. B. M.

Callopistria obscura.

Callopistria obscura, Butler, Ann. & Mag. Nat. Hist. (5) i. p. 200 (1878); Ill. Typ. Lep. Het. iii. p. 21, pl. xlvi. fig. 3 (1879).

Hakodate, Yokohama, Tokio, Shanghai. Type Coll. B. M.

Callopistria floridensis.

Eriopus floridensis, Guenée, Noct. ii. p. 292. n. 1094.

Florida and St. Domingo. Type Coll. B. M.

Cotanda, Moore.

Type *Cotanda placodoides.*

Eriopus placodoides, Guenée, Noct. ii. p. 296. n. 110 *b*.

Java and Nilgiris. Type Coll. B. M.

Cotanda æthiops.

Callopistria æthiops, Butler, Ann. & Mag. Nat. Hist. (5) i. p. 200 (1878); Ill. Typ. Lep. Het. iii. p. 21, pl. xlvi. fig. 4 (1879).

Japan and Nilgiris. Type Coll. B. M.

Cotanda duplicilinea.

Plusia duplicilinea, Walker, Journ. Linn. Soc. vii. p. 70.

Sarawak. Coll. B. M.

Cotanda indica, sp. n. (Pl. IX. figs. 8, 8 *a*, 8 *b*.)

Callopistria Yerburii, Butler, Ill. Typ. Lep. Het. vii. p. 12, Index (1889).

Very like *Hemipachycera Yerburii*, but differing in structure, in the presence of a pencil of long bristles at base of primaries, and a fringe of long hairs on inner margin near external angle, in its deeper coloration, in the outer margin of the central belt of primaries being much less sinuous, the discoidal markings more sharply defined in white and with a diffused ochreous patch below them; the vertex of the head whitish at the margins.

Expanse of wings 29 millim.

Dharmsala, Canara, and Sarawak. Type Coll. B. M.

Rhoptrotrichia, Butler.

Type *Rhoptrotrichia recurvata*. (Pl. IX. figs. 10, 10 *a*.)

Callopistria recurvata, Moore, Descr. Lep. Ind. Atk. ii. p. 144 (1882); Lep. Ceyl. iii. p. 60, pl. cli. fig. 1 (1884).

Ceylon, Java, Jubbulpore, New Hebrides. Coll. B. M.

Rhoptrotrichia argyrosticta.

Perigea? argyrosticta, Butler, Trans. Ent. Soc. 1881, p. 177.

Tokio. Type Coll. B. M.

The type specimen is in poor condition, the fringes being lost and the antennæ broken; but the right antenna is sufficiently perfect to show that the species belongs to this genus.

Eriopus granitosa, Guen. Noct. ii. p. 295, from North America, and *Eriopus ganga*, p. 293, locality unknown, are not known to me.

Phalæna-Noctua juventina, Cramer, Pap. Exot. iv. pl. cccc. N, from Surinam, is not in the Museum collection; it may be a *Callopistria*.

Callopistria rosci elum, Walker, Lep. Het. xii. p. 864, from the Congo, is *Methorasa Latreillei*.

Walker described the two following in Mr. Saunders's collection:—

Callopistria ventralis, Journ. Linn. Soc. vii. p. 64, from Borneo.

Callopistria vittata, Lep. Het., Suppl. 3, p. 811, from Brazil.

The following have also been described or figured:—

Eriopus elegantulus, Herrich-Schäffer, Corr.-Blatt zool.-min. Ver. Regensb. 1868, p. 117. From Cuba.

Eriopus Doleschalli, Felder, Reise der Nov., Lep. 4, pl. cxi. fig. 14 (1874). From Amboina.

Eriopus Wallacei, Felder, *l. c.* fig. 26. From Amboina.

Eriopus decumana, Felder, *l. c.* pl. cx. fig. 25. Brazil.

Eriopus miranda, Saalmüller, Ber. senck. Ges. 1879–80, p. 273. From Nossi-Bé.

Methorasa Thwaitesii, Moore, Lep. Ceylon, p. 61, pl. cli. fig. 2.

Eriopus reticulata, Pagenstecher, JB. nass. Ver. xxxvii. p. 226, pl. vi. fig. 7 (1884). From Amboina.

Eriopus jamaicensis, Moeschler, Abh. senck. Ges. xiv. p. 52 (sep. pag.), pl., fig. 24 (1886). Jamaica.

Eriopus venus, Staudinger, Stett. ent. Zeit. xlix. p. 253 (1888). From Amur-land.

Eriopus albolineola, Graeser, Berliner ent. Zeit. xxxii. p. 337 (1888). Amur.

Callopistria mexicana, Druce, Biol. Centr.-Amer., Het. p. 323, pl. xxx. fig. 1 (1889).

Callopistria panamensis, Druce, *l. c.* p. 324, pl. xxx. fig. 2 (1889).

Without examining specimens of the above I cannot venture to refer them to their proper genera; with regard to Felder's species, which are figured, they are neither related to one another nor have they any affinity to *Callopistria*.

The genus *Lineopalpa*, Guen., from Java, has no connexion with *Callopistria*, but is allied to *Amphigonia*.

EXPLANATION OF PLATE IX.

Figs. 1, 1 *a.* Legs and antennæ of *Gnamptocera minuta.*
Fig. 2. Legs of *Methorasa Latreillei.*
Figs. 3, 3 *a.* Legs and abdomen of *Haploolophus mollissimus.*
Fig. 4. *Dissolophus aluensis.*
Fig. 5. Legs of *Dissolophus repletus.*
Fig. 6. Legs of *Hyperdasys exotica.*
Fig. 7. Legs of *Hemipachycera rivularis.*
Figs. 8, 8 *a*, 8 *b.* *Cotanda indica*, antenna and legs.
Figs. 9, 9 *a.* Legs and antennæ of *Callopistria purpureofasciata.*
Figs. 10, 10 *a.* Legs and antennæ of *Rhoptrotrichia recurvata.*

VIII.—*Descriptions of Four new Species of Butterflies from South-west Madagascar, captured by Mr. J. T. Last, in the Collection of H. Grose Smith.* By H. Grose Smith.

Papilio morondavana.

Anterior wings narrower, more curved on costal margin and more concave on outer margin than in *P. demoleus*, Linn., and *P. erithonioides*, Grose Smith. Posterior wings of both sexes with a tail $\frac{1}{4}$ inch long.

Male.—Upperside. Anterior wings with markings very nearly as in *erithonioides*, the basal third being densely irrorated with stramineous scales in lieu of the small spots or lines of the same colour arranged in nearly parallel rows in *erithonioides*. Posterior wings with the subbasal stramineous band broader than in *erithonioides*, and on the costal margin extending rather broadly round the subapical ocellus, the outer part of the band between the costal and subcostal nervures being brightly ferruginous; the spots in the submarginal row are smaller and less lunulate outwardly, and the black spot at the lower end of the rufous anal spot of *erithonioides* is absent, the rufous spot of *morondavana* being rounder and paler; the space between the submarginal row and the band is more densely irrorated with stramineous scales.

Underside resembles *erithonioides*, but is paler. On the anterior wings the longitudinal stramineous bars at the base are confluent and less elongated than in *erithonioides*; the space

between the end of the cell and the third spot in the discal row of spots is densely irrorated with stramineous scales, the corresponding space in *erithonioides* being devoid of such scales. On posterior wings the dark markings are less conspicuous and the subapical ocellus is more elongate-ovate, surrounded with a narrower black line than in *erithonioides*; on the disk in the spaces between the nervules and surrounding the cell is an irregular row of triangular black markings (the two uppermost hastate), bordered outwardly with silvery bluish-white ill-defined spots; the submarginal spots are more conical and nearer the margin, the marginal lunules are narrower and more elongate, those on each side of the tail extending down it nearly to its end; the rufous anal spot is sharply triangular, with the apex downwards, instead of being quadrangular, with a black bar below it; the space above the rufous spot is silvery bluish white. The antennæ of both sexes are red, as are those of the female of *erithonioides*; the antennæ of the male of the latter and of both sexes of *demoleus* are black.

The *female* resembles the male, but is larger.

Expanse of wings, ♂ $4\frac{3}{8}$, ♀ $4\frac{3}{4}$ inches.

Hab. Mahobo, Morondava River, West Madagascar.

Belenois mabella.

Male.—Upperside. Both wings lacteous white, irrorated with grey at the base. Anterior wings with the apical third broadly, and thence along the outer margin to a little beyond the lowest median nervule gradually becoming more narrowly greyish black, somewhat irrorated with white; a round greyish-black spot at the end of the cell, a greyish-black ill-defined bar across the disk parallel with the outer margin from and a little above the upper median nervule almost to the submedian nervure, broader between the upper and middle median nervules, on each of which at its outer edge it becomes contiguous with the marginal band; between the second median nervule and the submedian nervure the bar is much narrower and partly obsolete; costal and outer margins almost to the submedian nervure black. Posterior wings without markings, except a few indistinct clusters of grey scales at the ends of the veins; cilia towards the anal angle (which is tinged with pale yellow-grey).

Underside. Anterior wings lacteous white, tinged with yellow at the base and along the costa, and broadly so at the apex; a black spot at the end of the cell. Posterior wings bright stramineous.

Female.—Upperside. Anterior wings dusky stramineous, base and costa grey; apical area broadly dark grey, gradually narrowing along the outer margin down to the posterior angle, the inner edge angulated on the veins; a large grey spot at the end of the cell; the discal bar of the male is represented by a grey spot between the two upper median nervules, and another between the lowest median nervule and the submedian nervure rather nearer the base. Posterior wings more yellowish stramineous, all the veins tipped on the margin with large suboval grey spots; there is an indication of an inner row of grey spots, represented by several clusters of grey scales.

Underside. Anterior wings sordid stramineous, brighter at the base and in the apical area, with the large spot at the end of the cell and the two discal spots as on the upperside. Posterior wings brighter stramineous; costa at the base orange.

Expanse of wings 2 inches.

Hab. Mahobo.

The female bears a considerable resemblance to *B. liliana*, Grose Smith, but the male is quite different.

One or both of these, as well as the species next described, may be referable to the genus *Pinacopteryx*, Wallengren.

Belenois mahobo.

Male.—Upperside. Both wings lacteous white, with a few grey scales at the base. Anterior wings with apical and outer marginal area grey, as in *B. mabella*, but less broadly so; a minute grey spot at the end of the cell; a cluster of grey scales, forming an indistinct spot on the disk, between the upper and middle median nervules. Posterior wings without any markings.

Underside resembles *mabella*, but the apex of anterior and the whole of the posterior wings is rather browner; the spot at the end of the cell of anterior wings is very minute.

Female.—Upperside. Both wings pure white, irrorated with grey at the base. Anterior wings: apex grey, as in the male, with a minute spot at the end of the cell; a cluster of grey scales forming a spot, larger and further from the margin than in the male, between the upper and middle median nervules. Posterior wings without any markings or grey scales except at the base.

Underside. Anterior wings sordid white, pale brownish stramineous at the apex, with the spots at the end of the cell and on the disk as on the upperside. Posterior wings

brownish stramineous, with a small brownish-black spot on the upper discocellular nervule and a row of three indistinct minute brown spots across the disk in the interspaces between the median nervules; costa at the base pale orange, outer margin white.

Expanse of wings $1\frac{7}{8}$ inches.

Hab. Mahobo.

The male is very near *mabella*, but the female shows that it is distinct.

Libythea tsiandava.

Male.—*Upperside.* Anterior wings resemble those of *L. laius*, Trimen, but the fulvous longitudinal bar in the cell is uninterrupted and wider than in *laius*, and the subovate discal spot, which is traversed by the second median nervule, is larger. On the posterior wings it also resembles *laius*, but the small ochreous spot of *laius* above the second subcostal nervule is absent, and in the straight longitudinal bar of four contiguous spots beyond the middle the second spot is the largest, instead of the first, as in *laius*.

On the *underside* it is paler and browner than *laius*, and on the anterior wings the pale fulvous colouring of the bar and spots extends below the cell and over nearly the whole of the central area of the wings.

Expanse of wings $1\frac{3}{4}$ inch.

Hab. Mahobo.

IX.—*On* Pherusa fucicola, *Leach.* By Alfred O. Walker.

To the Editors of the Annals and Magazine of Natural History.

Gentlemen,—The fact that a principle of considerable importance in zoological nomenclature is involved must be my excuse for troubling you again on the above question. Either No. 11 of Strickland's Rules for Zoological Nomenclature, adopted and confirmed by strong committees of the British Association, should be observed, or it should be condemned as authoritatively as it was accepted; and if it is ever to be observed, it surely should be in such a case as this, where the original definition of both genus and species is not only insufficient, but positively misleading.

Mr. Pocock ('Annals,' June 1891, p. 533) says:—"All that those who hold to" Rule 11 "can expect is that an author should point out such characters as are believed in his day to be essential." He then quotes my article, in which I state that *Pherusa fucicola* disagrees in almost every particular with Leach's definition both of its genus and subdivision, and says that this is substantially true of the later description in the Linn. Trans, but not of the original description in the Edinb. Encycl. But, in the first place, the only important difference between the two descriptions is that the latter contains the correct addition that the tail is not "fasciculato-spinosa" and the incorrect one that there is no secondary appendage to the upper antennæ. If we are to accept this view, then we shall come to the *reductio ad absurdum* that the more indefinite our descriptions are the better, and that if Leach had simply described *Pherusa* as an "animal having legs" his position would have been unassailable! In the second place, as will be seen by reference to p. 533, Leach went altogether wrong in his classification of *Pherusa.* His division *a*, including *Melita* and *Mæra*, is obviously founded on the characters of the males, in which the second gnathopods are very much larger than the first, while in the females the difference is trifling. *And this is precisely the case with Gammarella brevicaudata*; so that had Leach known the male he would certainly have placed his *Pherusa* in division *a*, and not in *c*! Can it then be said that Leach "pointed out such characters as" he "believed to be essential"? What carcinologist, with only the Edinb. Encycl. description to go upon, would have dreamt of referring *Gammarella* to *Pherusa*? Much rather would he have thought it referred to one of the large family of Lysianassinæ, in which the first and second gnathopods are nearly always "filiform" (as Leach would have called them) in both sexes, but whose affinities are sufficiently remote from *Pherusa* (*Gammarella*).

As regards the retention of Bate's genus *Pherusa*, 1862, I must unreservedly admit that Mr. Pocock is right and I am wrong. In my anxiety to avoid encumbering our list with another genus, and also in the hope that it might be found possible to absorb the present species of *Pherusa* (of which there appear from the 'Challenger' Bibliography to be eight) into other existing genera, I did not consider the possibility of other authors between 1815 and 1862 having used the name. As Mr. Pocock says, and as Dr. Norman had previously pointed out to me, this has been done in more than

one instance. *Pherusa*, Bate, is therefore inadmissible, and I propose to substitute the name *Apherusa* (*a* = not) for "*Pherusa*, Bate," on p. 421, 'Annals' for May 1891.

ALFRED O. WALKER.

Nant-y-Glyn, Colwyn Bay,
June 4, 1891.

X.—*On the Occurrence of* Discoglossus *in the Lower Miocene of Germany.* By G. A. BOULENGER.

WHILST accidentally looking at some fossil frogs exhibited in the Geological Galleries of the Natural-History Museum a specimen caught my eye as so closely resembling the living *Discoglossus pictus* that I determined to submit it to a careful examination. It is described in the recently published fourth part of the 'Catalogue of the Fossil Reptilia and Amphibia' by Mr. Lydekker as *Rana Meriani*, H. v. Meyer, with the following particulars:—

"35657. Slab of lignite with the impression and some of the bones of a rather smaller skeleton, from Rott. One humerus is entire. This specimen agrees very closely in size with the skeleton figured by Meyer, *op. cit.* pl. xvi. fig. 3. The contour of the soft parts is exhibited. *Purchased*, 1859" *.

Now *Rana Meriani* is a true *Rana*, closely allied to *R. esculenta*, as shown by the skull and the vomerine teeth, and as correctly stated by H. v. Meyer, not to *R. temporaria*, as suggested by Mr. Lydekker. The specimen under consideration, on the other hand, is a Discoglossoid, as the arciferous pectoral arch, the impressions of opisthocœlous vertebræ, and the presence of transverse processes to the coccygeal style distinctly indicate. The fourth vertebra even shows, as an impression, one of the ribs which are characteristic of the anterior vertebræ of the Discoglossidæ.

In all those features which can be distinguished it agrees very closely with the female *Discoglossus pictus*, particularly in the following characters:—

a. The proportions, as shown by the bones and the impression of the soft parts. These are given approximately in the first column in comparison with those of a female *Discoglossus pictus* from Spain, recorded in the second column.

* I may add that the specimen is exposed ventrally.

	millim.	millim.
From snout to vent	67	55
Length of head	21	16
Width of head	26	19
Dorsal vertebral column	21	18
Coccyx	24	19
Femur	27	23
Tibia	32	26
Tarsus	27	24
Foot	21	18

The differences are no greater than can be found between individuals of the same species.

b. The shape of the fronto-parietals, which are narrower behind than in front, and the large size of the nasals or præfrontals.

c. The comparatively feeble expansion of the transverse process of the sacral vertebra, the distal diameter being inferior to the length of the process.

d. The length of the coccygeal style, which a little exceeds the length of the dorsal vertebral column.

e. The short web between the toes.

On turning to H. v. Meyer's paper on the fossil frogs * I find a specimen, likewise from the lignite of Rott, near Bonn, described and figured as *Rana Troschelii* † which agrees with the above specimen except in its smaller size. This *R. Troschelii* had been compared with *Alytes* by H. v. Meyer on account of its having ribs, and for that reason alone; but I cannot find any further resemblance, for *Alytes* has the sacral processes strongly dilated, the coccyx shorter than the dorsal vertebral column, the fronto-parietals wider throughout, and a stouter, more toad-like habitus. I therefore cannot conceive what induced Cope ‡ to state that *Rana Troschelii* is "undoubtedly an *Alytes*." However, the frog has since generally passed under the name of *Alytes Troschelii*. This name I now propose to alter to *Discoglossus Troschelii*, regarding the type specimen as young and the specimen 35657 in the British Museum as an adult female.

Zittel, in his 'Manual,' p. 431, mentions *Discoglossus* from the Brown Coal, this statement being based on the identification of isolated mandibles. I do not know, however, and Dr. Zittel does not tell us, how to distinguish a mandible of

* 'Palæontographica,' vii., 1860, pp. 123–182, pls. xvi.–xxii.

† The name of this frog occurs twice over in Zittel's 'Manual,'—as a *Rana* on p. 428, as an *Alytes* on p. 431.

‡ Nat. Hist. Review, 1865, p. 106, footnote.

Discoglossus from that of other Discoglossidæ *; but there is a character in the maxillary which is very striking and which I think I can discern in the fossil, although I am not quite sure about it—that is, this bone sends up a broad process which joins the anterior limb of the T-shaped squamosal, whilst in *Alytes* and *Bombinator* the maxillary tapers posteriorly without sending off any sort of process.

XI.—*Description of a new Genus of Iguanoid Lizards.* By G. A. Boulenger.

Aptycholæmus.

Tympanum distinct. Body cylindrical; no dorso-nuchal crest. Dorsal scales equal, juxtaposed, keeled; lateral scales granular; ventral scales imbricate and keeled. Head-scales small; no gular fold, no gular sac. No femoral or præanal pores. Digits subcylindrical, with smooth lamellæ below. Tail very long, cylindrical. Lateral teeth tricuspid; pterygoid teeth present. No sternal fontanelle. Abdominal ribs.

This genus is allied to *Urostrophus*, D. & B., and *Anisolepis*, Blgr., but differs from both in the absence of a gular fold and in the dorsal lepidosis.

Aptycholæmus longicauda.

Head rather small, body elongate. Nostril lateral, near the end of the snout; ear-opening small, suboval, oblique. Upper head-scales rather small and smooth, smallest on the supraocular region, largest on the snout; occipital slightly enlarged, larger than the ear-opening; upper labials eight or nine, very low. Anterior gular scales small, equal, granular, keeled. Dorsal scales mostly hexagonal, strongly keeled, forming about twelve longitudinal series, passing gradually into the small granules which cover the sides. Ventral scales much larger than dorsals, strongly keeled, shortly mucronate, imbricate, in 16 to 18 longitudinal series; the keels forming straight longitudinal lines. The adpressed hind limb reaches the shoulder, or halfway between the fore limb and the ear. Tail at least three times as long as head and body, covered

* The mandibles of the Discoglossidæ and Pelobatidæ differ from those of all other European frogs in the absence of symphysial or mento-meckelian bones.

with uniform, imbricate, keeled scales. Pale brown above, with a darker broad dorsal stripe, which may be edged on each side by a fine blackish line; a blackish streak on the canthus rostralis, and a brown black-edged streak from the eye to the neck, passing through the tympanum; upper lip and lower parts cream-coloured.

	♂. millim.	♀. millim.
Total length	348	320
Head	18	17
Width of head	10	9
Body	60	63
Fore limb	33	32
Hind limb	52	50
Tail	270	240

Four specimens have been submitted to me by Professor Lütken, one of which I have been permitted to retain for the British Museum. They are from Riacho del Oro, Argentina, obtained in 1887 by Mr. W. Sörensen.

I beg to record my best thanks to Professor Lütken for his courtesy in allowing me to describe this interesting lizard.

XII.—*Contributions towards a General History of the Marine Polyzoa*, 1880–91.—*Appendix*. By the Rev. THOMAS HINCKS, B.A., F.R.S.

IN the following Appendix such errors as have been noticed in the series of papers which it brings to a close are corrected, and at the same time any changes rendered necessary by the progress of investigation have been introduced. But the discussion of a number of systematic and other questions, suggested by the papers, must be reserved for a future occasion.

'Annals,' July 1880 (p. 3 sep.) *.

Membranipora crassimarginata, sp. n.

Busk has identified this species with a form which occurs in the 'Challenger' collection †; but there are important differences between the two, and after an examination of the 'Challenger' specimens I have little doubt that they must be

* Reference is made to the number of the 'Annals' in which the paper appeared and to the paging of the separate copies.

† 'Challenger' Report on the Polyzoa, pt. i. p. 63, pl. xv. figs. 3, 5.

accounted distinct. Busk describes two varieties of his species, one with a crustaceous the other with an erect habit of growth. It is with the former (var. *incrustans*) that he identifies the Madeiran species. The points of difference are the much more robust and massive character of *M. crassimarginata*, the unusual thickness and strong crenation of the cell-margin, the depth of the cell-wall, which can be seen in the interspaces between the zooecia, and the form of the avicularian cell, which is perfectly oval, like the zooecium, and bears a straight mandible, rounded at the extremity, whilst that of Busk's species is "broadly spatulate." The general character of the cell in *M. crassimarginata* presents a contrast to that of the 'Challenger' form, which is heightened by the entire absence in the latter of its most marked feature—the broad, deeply cut (crenated) margin.

Busk gives *Biflustra Lacroixii* of Smitt ('Floridan Bryozoa,' pt. ii. p. 18) as a possible synonym of his var. *incrustans*. It may be so, but it is certainly not the Madeiran species.

Ibid. (p. 6 sep.).

Cribrilina radiata, Moll, var.

Busk in his description of Madeiran Polyzoa in Quart. Journ. Micr. Sci. vol. vii. (1859), figures a variety of *C. radiata* which agrees in most respects with the above, and notably in the remarkable elongation of the avicularium. In the same volume of the Micr. Journ. he records the occurrence of *Lepralia Pouilletii*, Aud., and remarks that it is readily distinguished from *C. radiata* "by the absence of the large avicularia and the uniformity of the front of the cell."

But the avicularium is very commonly absent in *C. radiata*, and when present exhibits many varieties of form. The front wall, too, is liable to much variation, especially in the character of the transverse ridges and central keel *. When the keel is absent and the transverse ridges are but slightly developed the cell presents the appearance represented in Audouin's *Flustra Pouilletii*, which must certainly rank as one of the synonyms of *C. radiata*, Moll.

There is also a good deal of variability in the superficial characters of the oœcium, which does not seem to have attracted much attention. Savigny figures in *Flustra Pouilletii* a simple raised line passing backwards from the centre of the oral arch. In a form figured in my 'History'

* See my 'History of the Brit. Marine Polyzoa,' pp. 187–189, and pl. xxv. figs. 1–9.

(pl. xxv. fig. 2) a subtriangular space on the front of the oœcium is inclosed by prominent raised lines, whilst in the Madeiran specimen its place is occupied by a smooth, subacuminate elevation which stretches upward from the oral arch. Such differences in superficial detail have little systematic significance.

Ibid. (p. 6 sep.).

Microporella decorata, Reuss (sp.).

Syn. *Microporella diadema*, MacGillivray, Prodromus Zool. Victoria, decade iv. p. 30, pl. xxxvii. fig. 6; Hincks, "Contributions" &c., Ann. & Mag. Nat. Hist. ser. 5, vol. xv. p. 249, pl. viii. figs. 3.

The oœcium is liable to considerable variation. Compare the figure in Manzoni's 'Bryozoi fossil. Italiani,' pt. ii. pl. i. fig. 6, with MacGillivray's. "The broad band of vertical beaded lines," which is so marked a feature of the recent form, is represented in the fossil by a line of small nodules round the base of the oœcium, which is not even referred to in the description.

In the account of *M. decorata* I have referred to *Microporella violacea*, Johnston (sp.); but this species, we now know, should probably be included in the genus *Adeona* *, Lamouroux, the genus *Reptadeonella* of the 'Challenger' Report being quite untenable.

Ibid. (p. 8 sep.).

Schizoporella sanguinea, Norman.

Additional Locality. South Africa (*Miss Jelly*).

Ibid. (p. 9 sep.).

Lepralia Kirchenpaueri, Heller, var. *teres*.

The Madeiran form, which I have regarded as a variety of Heller's species, Mr. Waters would refer to *L. Poissonii*, Audouin. On further consideration I am not disposed to adhere to my former opinion. The shape of the cell, which is much more distinctly given in Manzoni's figure than in Heller's, is very peculiar, and differs widely from that which is shown in my figure ('Annals,' ser. 5, vol. vi. pl. ix. figs. 7). A distinctive feature of Heller's species is the ribbed oœcium; but that of the Madeiran form is of small size and smooth

* See "Critical Notes on the Polyzoa," Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 158.

and the front is enclosed by a raised line. I therefore no longer identify these two. At the same time I am not prepared to accept Mr. Waters's alternative without a more careful examination of *L. Poissonii* than I am able to make at present. Besides other differences, the lower margin is represented in Savigny's figure as mucronate. If the Madeiran form is ranked under Audouin's species, it must be as a strongly marked variety.

Heller's *L. Kirchenpaueri* Waters would refer to *L. adpressa*, Busk. I confess I should be more inclined to recognize it as a distinct species. The peculiar shape of the cell, to which I have already referred, and the absence of vibracula are good specific characters, which separate it from *L. adpressa*, Busk (=*L. lata*, Busk). It is true that the latter is sometimes furnished with small nodular risings on each side a little below the orifice *, but these never bear vibracula and have no special significance.

Ibid. (p. 13 sep.).

Membranipora albida, sp. n.

This species is recorded doubtfully in the 'Challenger' Report as occurring at two stations. Mr. Busk remarks that the close resemblance between it and the 'Challenger' specimens "leaves little room for doubt as to their identity," the chief point of difference being the larger size of the avicularia in the former. There is undoubtedly a great similarity between the figures of the two forms. The *position* of the avicularium is the same in both; but there seem to be not unimportant differences in its structure as well as in size. Unfortunately the 'Challenger' description of it is much too meagre to allow of a satisfactory comparison; but if the details of the figure may be trusted, the avicularia represent two different types. The question can only be settled by an examination of the 'Challenger' specimens, which I have not had the opportunity of making in time for this paper.

Ibid. (p. 16 sep.).

Membranipora villosa, sp. n.

Syn. ? *Flustra Isabelleana*, d'Orbigny, Voyage &c. pl. viii.

D'Orbigny, in his 'Voyage dans l'Amérique méridionale,' has described a species under the name of *Flustra Isabelleana*, which presents some rather striking points of resemblance to

* 'History of Brit. Mar. Polyzoa,' p. 307, pl. xxxiii. fig. 6.

the present form. The cells are characterized as "pilose" or "covered with minute pilosities," elongate and narrow, and bituberculate above.

It is said to form large radiating patches on floating weed off the coasts of Patagonia and Cape Horn.

The diagnosis, after the fashion of the period in which it was published, is brief and insufficient, and the figure is certainly not a correct representation of *M. villosa*; but the salient feature of both is the same. The slender spinules covering the membranous front wall, and giving it a pilose appearance, are present in both forms, and, so far as I know, they are unique. The cells are similar in shape, elongate and rectangular; but in those of *F. Isabelleana* the side-walls are carried up on each side above into a mucronate process which is entirely wanting in *M. villosa*. In this species the upper margin of the cell is straight and bears on each side a tall acuminate spine. There are also a few small lateral spines, which are absent in the Cape-Horn species, and also a broad, membranous, strap-like appendage, pointed above, which rises from the centre of the upper margin in many of the cells, and constitutes a curious and very puzzling piece of structure. Round the *inner edge* of the cell there is a line of close-set minute spinules. There are said to be two tubercles on the cell below in d'Orbigny's species, of which I can find no trace in *M. villosa*. Taking his description as it stands we should hardly be justified in identifying the two forms, though it is possible after all that his species may have been founded on examples of *M. villosa*.

Ibid. (p. 20 sep.).

Membranipora antiqua, Busk.

The structure of this species and of others kindred to it had not been thoroughly investigated when my paper was written. We are indebted to Dr. Jullien for a valuable contribution to our knowledge of them and a discussion of their systematic position*. He has founded the genus *Onychocella* for species agreeing in general character with the *Membranipora antiqua* of Busk and the family Onychocellidæ for this and a number of related forms. While the structural type is fully and ably defined, an unnecessary number of genera, in my judgment, have been created, and undue stress has probably been laid

* "Note sur une nouvelle division des Bryozoaires Cheilostomiens,' Bull. de la Soc. Zoologique de France, t. vi., 1881.

on the characters of the avicularia in the constitution of the family group *.

The present species has been identified with the *M. angulosa* of Reuss, and this as the earlier name has been adopted instead of Busk's. I have not Reuss's work at hand as I write, and cannot therefore compare his figure with that of Busk. But the species has been figured by Manzoni in his 'Bryozoi fossili Italiani,' and he specially notes the constancy of shape exhibited by the opesia ("la bocca," as he calls it), which he describes as always maintaining the characteristic campanulate or horseshoe form, as shown in the figures of Reuss and in his own. Now the opesia of *Onychocella antiqua* is distinctly trifoliate, and markedly so †; it is much larger in proportion to the size of the aperture than in *angulosa*, placed at the very top of it, and occupying entirely (in my specimens) rather more than half of it. It is arched above and constricted a little above the lower margin by two prominent denticular projections, which form a kind of loop in each corner. The lower margin is raised towards the middle and slightly everted. Of the avicularium of course we can know but little in the fossil; but the differences in an important element of structure which I have pointed out may justify, I think, the retention of a separate name for each of the forms. For the present I shall record the recent species as *Onychocella antiqua*, Busk (sp.).

Jullien has formed a genus—*Smittipora*—of which he makes *Vincularia abyssicola*, Smitt, the type. But, in point of fact, there are no differences of any significance between this species and *Onychocella antiqua*. The chief distinctive point seems to be that in the latter the tall, slender, chitinous rod with triangular base which constitutes the mandible has a membranous expansion along one side of it only, while the former has it on both sides. This, with a slight variation in the surface of the cryptocyst, is the basis of the genus. The genus *Smittipora* is surely needless.

Ibid. (p. 20 sep.).

Membranipora mamillaris, Lamx. ‡

I am now inclined to think that I had not conclusive grounds for identifying the species described under this name

* "Critical Notes on the Polyzoa," Ann. & Mag. Nat. Hist. for February 1887.

† Occasionally it is subtrifoliate, but the typical form is not lost.

‡ Histoire d. Polypiers Coralligènes Flexibles (English transl.), pl. i. fig. 6.

with Lamouroux's *Flustra mamillaris*. Certainly neither his diagnosis nor his enlarged figure gives any adequate idea of the form in question. There is a certain general resemblance in the shape and arrangement of the cells, but that is all. The figure of the *natural size* indeed does closely resemble my specimens, and the "marine plant" on which it is represented as growing is, I believe, the same in both cases. The colour, too, may probably be the same in the two forms; but no means of sure identification are supplied. Under all the circumstances of the case, however, it may be better to *assume*, on the strength of such minor resemblances as there are, that Lamouroux had the present species before him, and so, to avoid a change of name, the species will stand as *Thairopora mamillaris*, Lamx.* (sp.).

In my notes on this species I have drawn attention to the importance of the opercular characters, and raised the question as to their generic significance. MacGillivray has since instituted the genus *Thairopora* for this and kindred forms. I quite agree with him that this genus finds its proper place amongst the Microporidæ.

Ibid. (p. 21 sep.).

Membranipora transversa.

As already explained in the number of the 'Annals' for Feb. 1881, Hutton was before me in describing this interesting form, and his specific name (*cincta*) takes the place of the above. MacGillivray has founded the genus *Diploporella* for its reception †, and places it in the family Microporidæ; but there may be a question, I think, as to its true systematic position.

'Annals,' November 1880 (p. 25 sep.).

Membranipora pedunculata, Manzoni.

Waters refers this form to the *Membranipora confluens*, Reuss, and it would be premature to say that he is wrong. But I may point out that the Ceylon species agrees much more exactly with Manzoni's description and figure than with those which he supplies ‡. The cells, as Manzoni

* For synonyms see Miss Jelly's 'Catalogue.'

† Trans. Roy. Soc. Victoria, April 1880.

‡ "Fossil Cheilostomatous Bryozoa from Mount Gambier, S. Australia," Quart. Journ. Geol. Soc. August 1882, p. 262.

has correctly stated, are suberect, and the aperture slopes towards the top, so as to be subterminal; as a consequence they have a very distinctive character. The aperture is oval, with a smooth raised margin, which is thin, except below, where it is elevated and sometimes thickened. There is a considerable space between the rim of the aperture and the membranous covering, and the inner cell-wall here is minutely speckled. The smooth porcellaneous outer wall is a striking feature, but this would hardly be preserved in the fossil. The cells taper downwards very decidedly, so as to be almost pedunculate; this is especially apparent in the uniserial colonies. Small rudimentary cells are scattered in considerable numbers amongst the normal zoœcia in the Ceylon specimens, but they are not noticed by Manzoni. The cells are very loosely aggregated.

The differences which I have noted are not without significance; but in the absence of specimens of the fossil form it is impossible to estimate their precise value. For the moment the point may be left *sub judice*.

Pyripora crassa *, MacGillivray, is another allied species, but I cannot satisfy myself of its identity with the form under consideration. "The thick projection from the lower margin of the aperture," which is made a capital character of *P. crassa*, is not represented in Manzoni's species. Its cells, too, seem to me to be much more Hippothooid in form than those which I have figured. If MacGillivray's species should prove to be identical with Manzoni's, his name would have precedence.

Ibid. (p. 26 sep.).

Membranipora polita, sp. n.

MacGillivray suggests that this species may be the *Cellepora alata* of Lamouroux; but there is no trace of the winglike structure from which this species takes its name, to say nothing of other differences.

[To be continued.]

* 'Zoology of Victoria,' decade xi. p. 23, pl. cvi. fig. 4.

BIBLIOGRAPHICAL NOTICES.

Some Publications on American Carboniferous Echinoderms.

Geological Survey of Missouri. Bulletin no. 4. *A Description of some Lower Carboniferous Crinoids from Missouri.* By S. A. Miller. Published by the Geological Survey. Jefferson City, February 1891.

Description of some new Genera and Species of Echinodermata from the Coal Measures and Subcarboniferous Rocks of Indiana, Missouri, and Iowa. By S. A. Miller and Wm. F. E. Gurley. Published at Danville, Illinois, June 1890.

That energetic species-maker, Mr. S. A. Miller, of Cincinnati, has again been hard at work, and, either alone or in collaboration with Mr. Gurley, who has been an active collector for many years, has made himself responsible for six new genera and over ninety new species of Crinoids from the Lower Carboniferous rocks of the Mississippi Valley. Forty-two of these new species and one new genus are described from Missouri, twenty of them occurring in the Burlington Group, in which over three hundred and fifty species of Crinoids are already known. Fourteen of these twenty are referred to *Platycrinus*, of which genus some three dozen species had previously been described from the Burlington beds, and ten of the new ones are founded on single specimens! Considering the richness of the Crinoid fauna in the Burlington Limestone, one might naturally expect that the affinities of Miller's new species to those previously described would be indicated by their founder. But he seems to be almost entirely unacquainted with the first duty of a species-maker, and only gives this much-needed information about three species of *Platycrinus*, two of *Barycrinus*, and one of *Scaphiocrinus*, while the remaining thirty-five are described and nothing more.

The new genus *Missouricrinus* has a monocyclic basin-shaped calyx, with the anterior ray undivided and a single axillary in each of the others. The anal plate (Bather's brachianal) separates two radials and rests upon the truncated apex of a basal, just as in *Cyathocrinus*. According to the author "the affinities are nearest the Heterocrinidæ; but I think a new family should be formed for it. Type *M. admonitus*."

This memoir is illustrated by five fairly good plates, though some of the figures would have gained in clearness had they been on a larger scale; and the explanations of plates iv. and v. would have been better arranged according to the numerical sequence of the figures, instead of beginning with fig. 7.

One more point is noteworthy. It is not many months since Mr. Miller thought fit to comment somewhat strongly on the "illiteracy" of the present writer, "for he even uses capital letters for specific names, or lower-case as it may be, showing his want of

a common knowledge of grammar, and recklessness in the symmetry of nomenclature." It is therefore not a little surprising to find no less than fifteen of Mr. Miller's specific names commencing with a capital letter. Perhaps he has discovered by this time that such is the custom in certain serial publications when a proper name is employed as the basis of a specific one.

The first twenty-five pages of the joint work by Messrs. Miller and Gurley, with four of the ten plates, were published in the 'Journal of the Cincinnati Society of Natural History' for April 1890. These have since been reprinted and published in pamphlet form, together with six more plates and thirty-four additional pages of text. Forty-nine new species of Crinoids are described, and another is mentioned though as yet unnamed. Thirty of these fifty are from the Keokuk Group of Indiana, eleven occur in the Upper Coal Measures of Missouri, and nine in the Kinderhook Group of Iowa. Time will show how far the authors are right in regarding all these forms as new to science; but the value of their work is seriously diminished by the fact that more than half of their specific descriptions are entirely unaccompanied by any words of comparison with forms already known from the same horizons. They vouchsafe a little more information about their new genera, some of which seem dubious in the extreme. Thus, for example, it is difficult to see in what respects *Ulocrinus* differs from *Cromyocrinus*, Trautschold, of which the authors seem to have never heard, though it is redefined in the 'Revision of the Palæocrinoidea' by Wachsmuth and Springer, who refer to it two species from the Kaskaskia Group of Illinois, together with one from the Coal Measures, the horizon of the three new species referred to *Ulocrinus.*

Æsiocrinus, Miller and Gurley, seems to be indistinguishable from *Phialocrinus*, Trautschold, which is also left unnoticed by our authors. *Æsiocrinus* has a dicyclic bowl-shaped calyx with the posterior basal truncated for the reception of an anal plate, and two costal plates (brachials, M. & G.) supporting simple arms. All these characters were described by Trautschold in *Phialocrinus patens* so long ago as 1879, as Messrs. Miller and Gurley ought to have known. I may say here that most, if not all, of the American species referred to *Graphiocrinus* by Wachsmuth and Springer should be placed under *Phialocrinus*, with which they agree in having the anal plate resting on a truncated basal, and so separating two radials; whereas in the type, and perhaps the only species, of *Graphiocrinus* (*G. encrinoides*, de Koninck and Le Hon) all the basals are alike and the anal plate rests on the upper edges of two of the radials which form a closed ring *. Wachsmuth and

* The species from the Coal Measures which White has described as *Erisocrinus planus* (Proc. U. S. Nat. Mus. vol. ii. 1880, p. 257, pl. i. figs. 6, 7) may perhaps belong to *Graphiocrinus*, as described by de Koninck. On the other hand, when its arm-structure is known, it may prove to have the same relation to this genus as *Ceriocrinus Craigii* and *C. hemisphæricus* have to *Phialocrinus.*

Springer state, however, that the anal plate of *Graphiocrinus* * is "placed between the radials, resting upon the truncate upper side of the posterior basal." I cannot understand why the American species presenting this character were referred by them to *Graphiocrinus* rather than to *Phialocrinus*, to which they are scarcely inclined to afford even a subgeneric rank. Messrs. Miller and Gurley are fortunate in having found the "proboscis" so well preserved in *Phialocrinus* (*Æsiocrinus*) *magnificus* and *P. Harii*, as it has not hitherto been properly known in this genus; and the bifurcating proboscis of the former species which is figured on their plate ii. is an abnormality of much interest.

A third equally doubtful genus is *Delocrinus*, M. & G., its type being *Poteriocrinus hemisphæricus*, Shumard, while the authors also refer to it *Cyathocrinus inflexus*, Geinitz, these being the same two types which White united under the name *Ceriocrinus*. But "in the 'North-American Geology and Palæontology' S. A. Miller condemned *Ceriocrinus* of White on the ground that the name was preoccupied" by Kœnig. Had he carried his literary researches a little further, however, as others of his countrymen have done, he would have learnt, firstly, that *Ceriocrinus*, Kœnig, is only a synonym of *Millericrinus*, and, secondly, that it was never described nor formally published. *Ceriocrinus*, White, is therefore a good genus, as already recognized by Wachsmuth and Springer, and *Delocrinus*, M. & G., only an unnecessary synonym †.

Abrotocrinus, as described by Miller and Gurley, is a somewhat remarkable type. The calyx is bowl-shaped and dicyclic, with a pentamerous base and apparently five radials, for there is no mention of any other number. In line with the radials is a "first azygous plate," of the same form as they have, which rests upon the upper sloping sides of two basals, and further resembles the radials in being "horizontally truncated the entire width above and having a gaping suture; second azygous plate constricted in the middle and horizontally truncated on top; above this numerous plates form a single longitudinal series until they graduate into the proboscis." We are elsewhere told, however, that only ten of these plates are visible "before the series is covered by the overlapping arm on the right."

The above description is a little difficult to follow; for it is not easy to understand how six equal and similar plates (five radials and one azygous plate) can rest in the depressions formed by the sloping upper sides of five contiguous basals. Three basals are shown in the figure of the azygous side, and also portions of three radials with the azygous plate, all four of which alternate regularly with the basals. The opposite side of the cup must therefore be remarkably unsymmetrical; but not a word is said about this in the

* "Revision of the Palæocrinoidea, Part III.," Proc. Acad. Nat. Sci. Philad. 1886, p. 176.

† The above paragraph has of course been written on the supposition that a generic name which has once been proposed, though not adopted, may be used again with a new signification.

description either of the genus or of the species. Each of the three visible radials bears a single axillary brachial united to it by a "gaping suture," and there is a similar gaping suture between the first and second azygous plates, which is a point of no little interest if the latter really supports the "proboscis," as described by the authors. But is their interpretation of this structure the correct one? This question is easily answered, for I have not the smallest doubt that the supposed proboscis is merely an undivided ray, like the anterior ray of Miller's own genus *Missouricrinus*, which has been noticed above. The first and second "azygous" plates in *Abrotocrinus cymosus* have precisely the same form and general relations as the anterior radial and the brachial which it bears in *Missouricrinus admonitus*. In each case the upper plate is quadrangular, separated externally from the lower one along its whole width, and followed by a series of simple plates which are obviously brachials in *Missouricrinus*. Is not this also the case in *Abrotocrinus*? Messrs. Miller and Gurley must forgive me for drawing attention to this point; for if their interpretation of the structure of *Abrotocrinus* is correct, it represents a morphological type of extreme interest in many ways, whereas if the supposed proboscis is merely an undivided anterior ray like that of *Missouricrinus*, the definition of *Abrotocrinus* will need considerable alteration, even if it still merits a generic position.

It is well known that among the Poteriocrinidæ the anterior ray is less developed than the others and is sometimes simple throughout. Messrs. Miller and Gurley intimate that *Abrotocrinus* probably belongs to this family and that its arms are like those of *Scaphiocrinus*. If they will refer to Hall's diagnosis of *Scaphiocrinus unicus* from the Keokuk Group of Indiana*, they may read as follows:—"Arms dividing on the second radial plate; each division bifurcating twice and rarely three times. The anterior ray has a single arm, which is undivided throughout. This single arm is a strongly distinctive character." The posterior side of the body and arms of this species is represented in fig. 5 on pl. xv. of the fifth volume of the 'Illinois Geological Reports;' while a reprint of Hall's description, together with a good figure showing both the real "proboscis" or ventral tube and the undivided anterior ray, are to be found in the sixth volume of the same series (p. 519, pl. xxix. fig. 1). I cannot myself make out that *Abrotocrinus cymosus* is either generically or specifically distinct from *Scaphiocrinus unicus*, which occurs on the same horizon and at no very distant locality in the same State.

In his well-known memoir on "New Species of Crinoidea from the Carboniferous Rocks of the Mississippi Valley"† Hall gave a full description of this species, which concluded as follows:—"This species may be readily distinguished from any other of the genus by the low, broad cup, the number and bifurcations of arms in the

* Prelim. Descr. New Crinoidea, 1861, p. 8.

† Journ. Boston Soc. Nat. Hist. vol. vii. no. 2, 1861 (1863), p. 314.

antero- and postero-lateral rays, the simple arm of the anterior ray, and the peculiar pits at the angles of the plates of the body." These pits are well shown in the figure of *Scaphiocrinus unicus* in the sixth volume of the 'Illinois Reports,' and they also appear in the figure of *Abrotocrinus cymosus* given by Miller and Gurley, who describe the plates as "sunken at the angles."

But how is it that they know so little about *Scaphiocrinus unicus* as to have described its undivided anterior ray as the "proboscis" of a new genus and species?

The 'Journal of the Boston Society of Natural History' and the 'Illinois Geological Reports' are neither written in German, which Mr. Miller abhors, nor published in Russia, like Trautschold's descriptions and figures of *Cromyocrinus* and *Phialocrinus*, which he also ignores; and it is not too much to expect that an American palæontologist should make himself acquainted with their contents before committing himself to the publication of new generic and specific types. Mr. Miller has recently told us how "it is high time American palæontologists would cease to look to England for information, where less is known of its own fossil Crinoids than happens to the lot of any other country in which there is any pretension to palæontological knowledge, and where more shallow pretenders vent their stupid hypotheses as to the fossil tests of these animals than exist in any other land." But it rather seems as if some American authors were not very well acquainted with the fossil Crinoids of their own country. I need not say that I do not refer to Mr. Wachsmuth, for whose comprehensive knowledge of the American Palæozoic Crinoids I have the most profound respect.

It would seem therefore, unless good reason can be shown to the contrary, that *Abrotocrinus*, *Æsiocrinus*, *Delocrinus*, and *Ulocrinus* are not new genera at all, but merely new names for types which are by no means so well known as they should be; and it is thus very unfortunate that the names selected by Messrs. Miller and Gurley should be so singularly inappropriate, for they tell us that ἄβροτος = immortal; αἴσιος = auspicious, coming at good time; δῆλος = manifest, clear; and οὖλος = solid, substantial!

The last of Messrs. Miller and Gurley's new Crinoidal genera is *Goniocrinus*, which seems to be a real novelty related to *Cyathocrinus*. A small quadrangular "azygous plate" is inserted between the upper sloping sides of two basals and the under sides of the right radial and the second azygous plate. The latter truncates a basal, "and is in line with the first radials and of about the same size; the three following plates are of the same size as the brachials and form a prominent convex ridge to the third brachials, when the series abruptly curves under the arms." Elsewhere we are told that it forms "a convex arm-like appendage that curves in toward the proboscis at or above the base of the free arms." In view of Bather's recent speculations concerning the morphology of the ventral tube in the Fistulata, one would like to know more about this genus, to which Miller's *Cyathocrinus Harrisi* should probably also be referred, as suggested by himself and Mr. Gurley.

Before leaving the subject of the Crinoids I would again appeal to Mr. Miller to discontinue the use of the term "subradials" for the upper series of plates in the base of dicyclic Crinoids. It has been obsolete in Europe for a dozen years past, and has been gradually abandoned by American authors, no one but Miller and Gurley having used it since 1886. Miller's generic and specific diagnoses are not always as clear as they might be; but he need not make matters worse by using an antiquated and empirical terminology which the student must translate into the current nomenclature of other palæontologists, as expounded in the text-books, before he can properly realize the characters of any "new" genus or species.

Besides the Crinoids, Miller and Gurley also describe a new starfish from the Kinderhook Group which they refer to *Schœnaster*, M. & W., under the name *S. legrandensis*. They likewise relate how Meek and Worthen "described an Ophiuroidea" (*sic*) from the Keokuk Group under the provisional name of *Protaster? gregarius*, some examples of which in Mr. Gurley's collection cannot be referred to Forbes's genus; and it is therefore made the type of *Aganaster*, Miller and Gurley, who think that they have found the remains of a second species as well. They also describe a new species of *Troostocrinus* (*T. nitidulus*) from the St. Louis Group, but omit all notice of its relations to the other species of the genus from the same horizon, while they give no information as to whether the posterior pair of spiracles are separate from the anal opening, as in *Metablastus*, or confluent with it, as in the type of *Troostocrinus*. The real generic position of this Blastoid has therefore yet to be determined. The last of Miller and Gurley's new species is *Archæocidaris legrandensis*, from the Kinderhook Group of Iowa, of which the authors remark, "This species is founded upon the fragment of a body, and our justification for naming and describing it is to be found in the fact that it is the oldest *Archæocidaris* known in America, and carries this genus back to the lowest Subcarboniferous deposits, whereas heretofore it has not been known below the Burlington Group." The authors' justification is to some extent admissible; but it may be well to remember that over twenty species of this genus have already been described from the American Carboniferous series, and they seem likely to give no little trouble to the echinologist who attempts to revise them.

I am sorry that I cannot speak more appreciatively of Mr. Miller's palæontological work. The demands of the legal profession doubtless leave him but little time that he can devote to the science, in the promotion of which he exhibits such zeal and energy. But he might employ these valuable qualities to much better advantage than in adding a number of unnecessary synonyms to an already overburdened literature. Three at least, and probably four, of his last six new genera of Crinoids would never have been proposed had he taken the trouble to make himself properly acquainted with the bibliography of his subject; and I suspect that quite half of his ninety new species will prove to be synonyms when they come to be revised.

Careless and ill-informed authors of this class are the terror of systematists in all branches of biology. Their sole object seems to be the association of their names with as many "new species" as possible; and one's first impulse on seeing "A Description of Some New Genera and Species" &c. is to parody "The Bogie Man," and say with bated breath,

Hush! Hush! Hush! Here comes the Species Man.

I will conclude by expressing my hope that Mr. Miller will take my remarks in good part; for he has recently made it very clear that he is extremely sensitive to criticism, more especially to some which appeared in "that conduit of English ignorance and conceit, the 'Annals and Magazine of Natural History,'" and was erroneously attributed by him to

P. Herbert Carpenter.

American Spiders and their Spinning Work. A Natural History of the Orb-weaving Spiders of the United States, with special regard to their Industry and Habits. By Henry C. McCook, D.D. &c. Published by the Author, Philadelphia. Vols. I. & II. 4to, demy.

That second thoughts are best is a saying which, whether true or false in the majority of instances, is undoubtedly deserving of the former epithet so far as the volumes before us are concerned. To write a natural history of all orders of North-American spiders was the author's original wish; but it soon became apparent that the attempt to compress into a reasonable space adequate descriptions of the habits and structure of such a multitude of species would inevitably result in the omission of many important facts and in the superficial treatment of others. Dr. McCook consequently very wisely decided to abandon his original design and to devote his work solely to an account of the Orbitelariæ of his country; and when we see that the history of even this small section of the group occupies three volumes quarto, we cannot but congratulate both ourselves and the author upon the alteration that his plans have undergone.

Up to the present time but two volumes out of the three have appeared; but since the third will treat almost exclusively of the technical descriptions of the genera and species, its publication will be looked forward to by merely those few zoologists who devote themselves to systematic araneology.

Seeing that one of the most notable characteristics of the Araneæ —certainly the characteristic with which the word spider is most commonly associated in the popular mind—is the construction of those familiar objects known as cobwebs, Dr. McCook has acted wisely in setting apart the first of his volumes to the consideration of the various kinds of snares, their formation, function, and classification. Moreover, a study of the nature of the snares is of great importance in view of the prominence that is given to these struc-

tures in the generally-accepted scheme of classification of the order Araneæ. This scheme, of which Dr. Thorell is the most able exponent, depends upon the fact that a classification of the webs according to their form corresponds closely with a classification of the spiders based upon the sum of their most obvious structural features. With the rival scheme *, which is established upon the existence in otherwise dissimilar genera of those curious organs known as the *cribellum* and *calamistrum*—a scheme for which Dr. Bertkau has said all that is to be said—we need not further deal. It will be sufficient to state that Dr. McCook, rightly in our opinion, adopts the views of Dr. Thorell, and associates with the Orbitelariæ the aberrant genera *Uloborus*, *Hyptiotes*, and *Theridiosoma*.

But a noticeable circumstance connected with this matter is that although, as above stated, a natural classification of the webs coincides with a natural classification of their makers, when the Araneæ as a whole are considered, yet the principle is found not to apply if an attempt be made to extend it to the suborder now under discussion. In other words, an obvious classification of the snares of the Orbitelariæ does not correspond with a classification of the species and genera according to their affinities as exemplified by structure. As an illustration of this may be pointed out the fact that within the limits of the genus *Epeira* webs of very different types may be constructed. The commonest type is a simple, vertical, full-orbed net with a meshed hub (*sic*); but in the species known as *Ep. labyrinthea* a system of netted lines is associated with the ordinary web; in *Ep. triaranea* the web is not full-orbed, but lacks one sector; the web of *Ep. gibberosa* is horizontal and not vertical; and, lastly, *Ep. basilica* weaves the remarkable net which Dr. McCook has described as the domed-orb. On the other hand, the web of *Gastracantha* is almost like the web of the ordinary type of *Epeira*; that of *Zilla*, not to mention *Nephila*, resembles that of *triaranea* in lacking a sector; that of *Tetragnatha* is like that of *gibberosa* in being horizontal. It appears, then, that there may be a greater difference between the webs of a species of a genus than between the webs of distinct genera; thus the web of *Epeira basilica* is far more unlike the web of, e. g., *Ep. diademata*, than is the web of *Zilla* or even *Argiope*.

Since, then, the form of the web is liable to so much variation within the limits of a single genus, and since species belonging to different genera may spin snares that are almost exactly alike, it is clear that great caution should be used in concluding that spiders which make webs on a particular plan are necessarily related to each other. But it is impossible to pursue this interesting topic further. Enough has been said to give some idea of, perhaps, what is one of the most important lessons to be learnt from Dr. McCook's researches into the nature of webs.

* For an able and exhaustive criticism of this classification reference may be made to Dr. Thorell's paper in the Ann. & Mag. Nat. Hist. vol. xvii. pp. 301–326 (1886).

We are surprised at the summary manner in which the view that spiders attach stones &c. to their webs as so-called counterpoises, is rejected. Dr. McCook is perfectly right to sift as carefully as he has done the evidence for or against the belief; but it is questionable whether he is correct in deciding that the attachment of such a weight would be harmful. Why so? A web blown by the wind would surely be more easily destroyed if all its points were attached to fixed objects, than if one or more strands were fastened to, *e. g.*, a pebble lying on the ground, which would "give," so to speak, when pulled by the strands under stress of the wind. Where something must "give," it is surely better for the spider that it should be the pebble than the web.

In Chap. xvi. of vol. i. Dr. McCook discusses at some length the question of spider venom. He starts with the assumption that the fluid secreted in the mandibles and ejected at the apex of the fang is poisonous. He then proceeds to show that it is perfectly harmless. Numerous cases are cited in support of this, Lucas even having been bitten by *Latrodectus* and Simon by the historical *Tarantula* without suffering harm. It is true that the universal testimony with regard to *Latrodectus* far outweighs almost any amount of negative evidence; and the conclusion that Dr. McCook finally comes to is that the poison is a sparingly used reserve weapon. This may be the case of course; but the explanation is not altogether satisfactory, for it is apparently the only one that can possibly be put forward if we assume the existence of a poison apparatus. But what evidence is there for the assumption? Certainly very little. Why may not the fluid be merely secreted for digestive purposes, such as, *e. g.*, for softening the tissues of the prey? To make a general statement with regard to all spiders from the particular case of *Latrodectus* is not justifiable. It may well be that in this genus the digestive fluid is harmful to man, while in all other spiders it is not. Indeed this seems to us to be the obvious conclusion from the facts at hand. With respect to the Theraphosidæ, as Dr. McCook himself suggests, it may well be that the fluid that is injected into a wound causes inflammation from its very amount.

The second volume is much more varied in its subject-matter than the first. Thus Part i. is devoted to Courtship and Mating; Part ii. to Maternal Industry and Instincts; Part iii. to Early Life and Distribution of the Species; Part iv. to Sexes and their relation to Habit; Part v. to Hostile Agents and their Influence; and Part vi. to Fossil Spiders. Frequent reference is made to groups which do not belong to the Orbitelariæ; while the section devoted to Fossil Spiders seems wholly out of place.

Clearly a considerable amount of the work of this volume has been robbed of its novelty by the prior publication on the part of the Peckhams of their articles on Sexual Selection, Protective Resemblances, and Mental Powers in Spiders. One or two points, however, may be noticed.

Commenting on the difference in the behaviour of a *Tarantula* and an *Epeira* when experimented on with a vibrating tuning-fork

—the *Tarantula* taking no notice whatever of the instrument, while the *Epeira* responds readily to it—Dr. McCook says that the difference is certainly to be explained by the fact that the fork agitates the strands of the web of the *Epeira*, and that the spider thereby ascertains its proximity by the sense of touch; he then proceeds (p. 304): "It would indeed be a remarkable fact were it to be established that those spiders which, like the Lycosids, are dependent upon keenness of the senses for their success in capturing prey, should prove to be destitute of the valuable sense of hearing; while the web-making spiders, who are so little dependent upon the sense of hearing, and are enabled to accomplish the most important functions of life by the sense of touch alone, should be found to possess hearing in a degree of acuteness. It is not often that one finds a contradiction like this in natural history, viz. that those animals that most need a certain organism or sense have none, while those which are in least need are highly sensitive." But if, as Dr. McCook maintains, the *Epeira* only perceives the vibration of the fork by means of the vibration of its web, how comes it that, at all events in some cases, it undoubtedly knows the direction of the sound? We have seen Mr. C. V. Boys hold a tuning-fork over the back of a large specimen of *Epeira diademata*; but instead of feeling at the strands of the web, as she surely would have done if her only means of ascertaining the proximity of the fork lay in the vibration of these strands, she struck viciously at the instrument in the air with her fore legs, thus showing beyond a doubt that she knew whence the sound proceeded. This fact, it seems to us, proves unquestionably that the *Epeira* heard the sound, probably by the responsive agitation of some hair or hairs on the body or limbs; for it is almost inconceivable that the spider's sense of touch can be sufficiently keen to inform her, in a case like this, of the position of the agitating agent. If this be so, we have to face and account for what Dr. McCook considers a "contradiction in natural history." For, whether remarkable or not, the simple fact will remain that, so far as we can judge by their actions, the *Epeira* has an auditory sense and a *Lycosa* has it not. But when criticised, this so-called contradiction merely amounts to an assumption, which after all may be but a fiction of the imagination. In the first place it must be remembered that a terrestrial species like a *Lycosa* must prey for the most part upon insects which, ground-lovers like itself, make little or no sound, or at least can only be heard when on the wing and out of the spider's reach. Therefore an auditory sense would not apparently be of the service to it that Dr. McCook makes out. On the other hand, an *Epeira* feeds almost wholly upon insects which are intercepted by its snare when buzzing on the wing. Consequently it is easily conceivable that some benefit is derived from the possession of a sense which would warn its owner of the approach of prey. But in the second place, it must also be remembered that the capture of prey is not the only necessary in life which might make the existence of an auditory sense beneficial. Avoidance of enemies is at least as important. Now in the chapter devoted to enemies and

their influence we read:—"Perhaps the most persistent and destructive natural enemies of spiders are certain Hymenopterous insects belonging to the large family of wasps . . ." Bearing this in mind, and at the same time remembering that the webs which are exposed for the capture of winged flies must at the same time of necessity be equally exposed to the attacks of the winged and marauding wasps, a close connexion can easily be traced between the existence in the Epeiridæ of an auditory sense and the enemies that attack them. Of course wasps often prey upon ground-spiders like the *Tarantula*; but it does not appear why an auditory sense should be of more use to a *Tarantula* in this connexion than to an *Epeira*. Is not exactly the opposite the case? The *Epeira*, owing to the exposed site of his web, must surely be much more liable to the attacks of wasps than is the *Tarantula*, which spins none. If this be so, then the power to hear would be of more service to the *Epeira* than to the *Tarantula*. Indeed, if the *Epeira* had no such sense, it seems that the advantage gained by the exposure of her snare for the interception of flies would be counter-balanced by the fact that this very method of obtaining her food would, *pari passu*, lay her open to the assaults of her enemies. We cannot then accept Dr. McCook's view of the matter until (1) he bases his objection to the one held by Mr. Peckham, which has been here supported, on something more stable than his "contradiction in natural history," and until (2) he shows how an *Epeira* can discover on which side of her web a vibrating tuning-fork is held, if she is only aware of its proximity through the responsive vibration of her snare.

In an interesting chapter on the ballooning of spiders the author seeks to account for the distribution of the widespread *Heteropoda venatoria* with reference to this habit. Thus it is found that the geographical belt over which this species is spread corresponds tolerably closely with the zone of the trade winds; and it is suggested that we may look upon these winds, in conjunction with the aeronautic habit, as the agents in the dispersal of the species. The suggestion is certainly interesting and at first seems reasonable enough when we recollect that young spiders may be carried to considerable distances through the air when hanging to their silken strands. But it is necessary not to lose sight of the fact that to say that the area of the distribution of a species corresponds with the area of the trades is only another way of stating that the species in question is a tropical one; consequently it is clear that the charts on pp. 269 and 270, explaining the connexion between these winds and the known localities for *H. venatoria*, will apply equally well to many wide-spread species, which certainly have not the means of travelling which are ascribed to this one. Thus we cannot accept Dr. McCook's theory until reasons are brought forward to show that the agencies which have effected the distribution of, e. g., *Isometrus maculatus* or *Scolopendra subspinipes* are inefficient to account for the similar distribution of *Heteropoda venatoria*. What these agents have been must still be a matter for debate.

But Dr. McCook advances certain arguments in an attempt to prove that in the case of *H. venatoria* man, at least, has not been one of them; for we read on p. 269, vol. ii., ". . . . the following facts warrant the theory that the Huntsman Spider has become cosmopolitan by the action of nature, independent of the aid of man: first, the early discovery of the species as already widely distributed; second, its presence at so many different insular points nearly or altogether contemporaneously with first visits of commercial nations; third, the existence of the species or its close allies among the fauna of the tropical interiors of continents far distant from coast-lines; fourth, the variations, chiefly in colour, which have been observed, and which would seem to require for their development a longer period than that which has transpired since the commencement of commercial communication with the localities in which the variations have been wrought."

Each of these arguments, however, is open to criticism—(1 and 2) *H. venatoria* has only been known for about 140 years, having been described by Linnæus in 1750 or thereabouts. What evidence, then, is there that the species was widely distributed when the world was first circumnavigated 200 years before Linnæus wrote? Again, supposing that Sir Francis Drake had brought examples of this species from all the localities that his vessel passed on his voyage round the world, what would this have shown? Merely that the distribution of the animal was not to be attributed to him. It would give no information whatsoever to justify the assumption that the spider had not been carried by previous visitors. Or, again, if it was an ascertained fact that *H. venatoria* was an inhabitant of the Antilles when Columbus first made known to Europeans the existence of these islands, would any one have the right to conclude therefrom that the spider had not been introduced there by man? Dr. McCook seems to have lost sight of the fact that this spider may have been carried to the various localities where it is found by far earlier colonists than history has any record of. Was the dingo not introduced into Australia by man because we do not know the date of its first appearance there? (3) What conclusion in support of Dr. McCook's view can possibly be drawn from the fact that the spider is found inland as well as on the coast? What is to prevent such a species from travelling to the interior when once it has effected a landing? Are we to conclude that the common rat and the common cockroach have not been brought to England in ships because they are not confined to our seaport towns? (4) With regard to the proposition respecting the colour variations, it is certain that Dr. McCook would be doing great service to zoology if he would publish what information he possesses on the question of the length of time required for the development of such variations. Undoubtedly evidence should be produced to show that certain varieties occur in certain localities. Otherwise we may well be excused for asking what reasons there are for thinking that the variations in colour are the result of a wide-spread range. It may be characteristic of the species to vary quite apart from its being

widely distributed. That differences in tint are not necessarily connected with distribution, we learn from the case of *Epeira trifolium*, which certainly has not a wide range as compared with *H. venatoria*. The colour variations of the former species are admirably shown on pl. i. of vol. ii. of this work, and on pp. 331 and 332 of the same volume we are told that variations in colour may be connected with moulting, age, gestation, muscular action, and sex. And conversely we are told that variation in environment is not always accompanied by variation in colour; for on p. 334 we read that ". . . certain species, as notably *Argiope cophinaria* and *argyraspis*, have undergone a transcontinental distribution, covering wide extremes of climate and conditions without experiencing any notable change in general appearance." Consequently it does not appear that the theory propounded with respect to the distribution of *H. venatoria* is established on a very secure basis.

Dr. McCook candidly expresses his belief in death-feigning (p. 444). This phrase, it appears, can only mean that a spider has a knowledge of death, and attempts to simulate the appearance of a dead brother spider in the hopes of deceiving a man or a lizard into the belief that there is no life in his carcase. This is attributing so much intelligence to the little animal that one is tempted to ask, How comes it that such a mind is not also aware that a dead body in that state of preservation is quite as acceptable as a living one to the collector's bottle or the lizard's palate? The hypothesis that the spider's sole thought, if we may use the word, is to "lie low," or, in other words, to keep still and occupy as small a space as possible, seems far simpler and meets all the facts of the case.

The subjects, however, open to criticism that a work of this kind presents are practically without end. Those that are here put forward are some few that occurred to us the first time of reading over. Many more no doubt remain. But on the whole the volumes are decidedly good, showing much care and thought; and we sincerely hope that ere long Dr. McCook will give us in a similar form the results of his researches into groups other than the Orbitelariæ.

R. I. P.

Catalog der Conchylien-Sammlung, von Fr. Paetel. Parts II. and III., 1889–1890.

A short notice of the first part of this work appeared in these 'Annals' for 1888 (vol. ii. pp. 420–422). The second and third parts, which complete the Catalogue, are now published.

This work, which purports to give a complete list of all the known families, genera, and species of shells, is the most extensive of the kind yet issued. No doubt it will be largely used by collectors who wish to ascertain the extent of their own collections, to mark off desiderata, to find out habitats, names of authors, &c., and as a plan to be followed in the arrangement of their cabinets.

As an assistance to scientific workers, however, it will be of less

value, for, as we pointed out in our criticism of the first part, it is not altogether reliable as regards completeness. In the two parts before us we find numerous omissions; indeed we do not notice any improvement in this respect. A number of the references are hopelessly contracted, so that it becomes a matter of guesswork which work may be referred to. As examples we may cite "Grass. Ind. Test.," "Pet. Moll. T.," "Mrts. Beitrg.," "Tapp. C. p. 287," "Mrts. Asia C. 83," "Dkr. Afric. M.," &c. The same remarkable contractions of authors' names appear in many instances. It will doubtless puzzle many conchologists to recognize the following writers:—Dub., Hilb., Budd., Lub., Watlb., Crras., Euth., Leo., Drgt., &c. We also notice in a few cases names given as authors' which are altogether incorrect, *e. g.* Yoldi and Valdiv., the former the name of the owner of a celebrated collection, the latter a contraction for Valdivia, a place in Chile. Sometimes names are variously abbreviated: for example, *De Morgan* appears as de Mon., d'Morg., Morg., and d. Morg.; *Brazier* is rendered Brac., Bruz., and Brazier; and *Craven* is written Crav., Craw., Crawen, and Craven.

The localities are frequently as enigmatical as the authors' names. It would be a matter of some difficulty to recognize the position of such places as these:—Jalap., Mach., Rum. Hill., Solothr., Nag., I. Aitut., Toni B., Tillow., Bet. gia., Tuk. Ber., &c.

In conclusion, we do not deny that the work possesses a certain usefulness; but this is certainly marred in the points we have indicated.

Foraminifera and Radiolaria from the Cretaceous of Manitoba. By Joseph B. Tyrrell, M.A., B.Sc., &c., of the Geological Survey of Canada. (Trans. Roy. Soc. of Canada, 1890.)

Mr. Tyrrell gives a succinct account of the researches and surveys whereby the natural sections in Manitoba are known to expose the several groups of Cretaceous strata, with their estimated thicknesses, as follow:—

		feet.
Laramie		?
Pierre	Odanah	500
	Millwood	500
Niobrara		200–540
Benton		130
Dakota		50–150

Besides visible sections of outcrops, the wells and deep borings have been utilized in obtaining a knowledge of the strata underlying the wide plains of the Canadian North-West. By the careful comparison of the successive beds met with in these borings, and especially by a microscopic examination of their respective materials, they can be identified, and the sections can be correlated —their relative characters and thicknesses can be noted—and not

only their geological history elucidated, but their height above the sea-level and the depth at which their water-bearing zones can be reached are ascertained.

Much careful labour has been given to this research, and a Radiolarian zone has been met with in the Millwood series at the Bell River in Porcupine Mountain, and the North-pine Creek in Duck Mountain. Dr. D. Rust, of Hanover, will describe and figure these microzoa for the Geological Survey of Canada. Abundant Foraminifera occur in the Niobrara division; upwards of twenty species are enumerated, some of which have been named for Mr. Tyrrell by Mr. C. D. Sherborn, F.G.S., of London. There are also coccoliths and rhabdoliths. Prisms of *Inoceramus* in some cases compose the rock, and particles of oyster-shell and fragments of teeth and scales of fishes are also present. The Foraminiferal Niobrara limestone is underlain by the dark grey Benton shales, containing a large amount of bituminous matter, with flakes and crystalline masses of selenite. The sands and clays of the Dakota formation, or basal sandstone of the Cretaceous series throughout the district, lie unconformably on the eroded surface of Palæozoic limestones and shales.

MISCELLANEOUS.

A Test Case for the Law of Priority. By F. Jeffrey Bell.

It is now recognized by, I think, every student of Echinoderms that the tenth edition of Linnæus's 'Systema Naturæ' is that which is to be cited. Those who, like myself, were content to accept the instructions of the British Association Code, were forced to adopt the more reasonable and general rule that the tenth edition, and not the twelfth, should be cited by the publication of Prof. Lovén's essay on the Echinoidea described by Linnæus.

I make, then, my major premiss, "the tenth edition of Linnæus is to be quoted."

My minor cannot be subject to discussion; it is the mere statement of a fact:—All the species placed by Linnæus in the genus *Holothuria* in the work cited are pelagic Hydroids or Tunicates.

The conclusion is obvious: the generic name *Holothuria* must not be applied to any "Holothurian," which, as an eminent geometer remarked, is absurd.

This is not the first occasion on which strict adherence to logic has landed the dialectician in, to say the least, an untenable position. How shall one escape?

It will probably be told me that if I would only obey rules laid down for me by my betters I should not have got into this scrape.

Let us see. In the twelfth edition (1767) Linnæus includes *frondosa*, *physalis*, and *thalia*, as well as others, in the genus—that

is, an Echinoderm, a Hydroid, and a Tunicate. Let us grant that, notwithstanding the existence of the tenth edition, which would indicate that an Echinoderm at any rate is not the type of the genus, "the evidence as to the original type of the genus is not perfectly clear and indisputable;" "then the person," says the B. A. rule, "who first subdivides the genus may affix the original name to any portion of it at his discretion."

The first writer *later than* 1767 was Pallas, who writes (1774) (Spic. Zool. s. v. *Holothurium zonarium*):—

"Holothuriorum genus a Linnaeo ultima in editione *systematis* miro modo compilatum et a natura alienum factum est, quum tamen illud in *editione decima* systematis satis bene institutum videretur. Eoque magis miror hanc *Ill. Viri* levitatem, cum sole meridiano clarior esse debeat, cuivis in studio Molluscorum initiato, affinitas *Holothurii frondosi*, *Phantapodis*, *Hydrae Bohadschii*, atque *Hol. pentactis* (Syst. ed. xii. p. 1089. 1090. 1091. sp. 1. 2. 3. 8.) cum *Actiniis* Brownii, (genere etiam a Linnaeo adoptato, maximeque naturali) ad quod istas Holothurias Linnaeo nunc dictas plerasque dudum retuli in Miscellaneis Zoologicis. p. 153."

Holothurium zonarium is an Ascidian, and some other name must be found for Holothurians.

But it will be remembered that Brisson's genera are allowed by the B. A. rules; was there no contemporary of Linnæus who used *Holothuria* for an Echinoderm? Yes, there was Bishop Gunnerus (Act. Stockholm, 1767, p. 115), who discusses the characters of the genus *Holothuria*, and is quoted by Linnæus himself.

Yet again, if we accept the testimony of the Bishop, who wrote in 1767, we must accept that of Pallas, who wrote in 1766 *, and who fully described and discussed *Actinia doliolum*. Now this is an Echinoderm, a Holothuroid, a Colochirus.

∴ *Actinia* is the correct generic name of a "Holothurian," and not of a Sea-Anemone.

Here, again, Euclid might be appropriately quoted.

So that, after all, obedience to the laws of the B. A. leaves us in a worse plight than before.

It is clear that two courses only are open here: one is to adopt Mr. Pocock's heroic but perfectly safe challenge to the skies, and enforce the changes required by strict adherence to the laws of priority; and the other is—if I, too, may quote from a Latin writer: "Spectatum admissi risum teneatis, amici?"—to avow a dislike to appearing foolish more often than one can help, and retain *Holothuria* and *Actinia* for groups to which they have been applied for more than a century.

To enforce the rule of priority here would be to strain it beyond breaking-point; where that point comes must, I suppose, be a matter for individual discretion; but in this case, I believe, zoologists will credit me with showing a little common-sense.

* Miscell. Zool. p. 152.

The Food-Stores of the Mole. By Dr. Fr. Dahl, of Kiel.

In the year 1886 I published, in the 'Schriften des naturwissenschaftlichen Vereins für Schleswig-Holstein,' an account of a large store of earthworms which had been found in the burrow of a mole. I then expressed the opinion that in all probability this was not a case of a winter food-store, as had hitherto been believed; on the contrary, since the supply was found at the end of a prolonged period of keen frost, we were rather led to the conclusion that it was precisely in winter that the mole was able to capture its prey most easily, and therefore in excess. However, I added that further observations were greatly to be desired.

Herr A. Schröter, a market-gardener of Hassee, near Kiel, then had the kindness to continue the observations in his own grounds, partly assisted by myself. I am especially grateful to him, since it is difficult for a town-dweller to select the right moments for observation.

On December 14, 1886, before the frost set in, we together examined two burrows: we found no stores. Herr Schröter then examined two burrows on Jan. 9, 1887, after a slight frost, and two more on March 6 of the same year, without discovering a store of worms. The winter this year was very mild, so that the ground was never frozen deep nor continuously.

At the beginning of the next winter, on Nov. 27, 1887, Herr Schröter again examined two burrows without finding stores. The next spring, however, after a prolonged and severe frost, there were found on April 8, 1888, in one of the burrows examined—

578 Earthworms;
67 larvæ of *Hepialus lupulinus*, L.;
4 Cockchafer grubs; and
3 larvæ of Skip-jack Beetles.

A second burrow which was examined at the same time was likewise filled with a number of worms.

At the commencement of the third winter, on Dec. 23, 1888, after a short slight frost, there were again no stores found. But on March 12, 1889, after a severe and long-continued frost, we found in the first burrow 550 earthworms, and the rest of the burrows exposed also contained large food-stores.

Before the beginning of last winter, on October 27, 1889, no worms were found, as was once more the case on Dec. 26, after a short slight frost. On the 18th of March there was again nothing found in the first of the burrows examined, while in the second there were only eight worms. It is true that in this year the soil was frozen for about three weeks, but the frost was very superficial.

The observations therefore completely confirmed my previous conclusion: it is only after a long-continued and severe frost that large stores of worms and larvæ are found. The mole must therefore be able to capture these creatures more easily during the rigours of winter. With reference to the condition of the worms, I wrote

as follows in my previous paper:—"Most of them were pretty severely crushed, in part even mutilated. Some, however, on being brought into a warm room, soon so far recovered again that no injury whatever could be perceived." This is not quite correct. In the year 1888 Dr. Döderlein informed me that his attention also had been drawn by an agriculturalist near Strassburg to the winter supplies of the mole. He stated that examination revealed the fact that the first segment of all the worms was severely injured, so that they could not burrow. A new investigation of my own completely confirmed this statement. In all the specimens the first segment was injured, and often several others besides. It is true that in many instances the wounds were already almost completely cicatrized; the most recently captured individuals were, however, still bleeding. The worms were therefore prevented from escaping not only through being securely imprisoned within the walls of the dwelling-chamber and passages, but also through this highly practical mutilation, and were nevertheless preserved alive. The crushings, which, as I stated previously, are not always present, are probably to be regarded as of a secondary nature, and result from the worms being pressed into the walls.—*Zoologischer Anzeiger*, Jahrg. xiv. no. 353, Jan. 5, 1891.

On the Development of the Chromatophores of Octopod Cephalopoda. By L. Joubin.

The anatomical structure of the chromatophores of adult Cephalopoda is now tolerably well understood, and the theory which attributed the movements of the pigmented matter to contractions of muscular fibres appears to be definitely abandoned; but people are far from being agreed as to the mode of development of these organs. Having had the opportunity of studying the embryogeny of *Argonauta* and *Octopus* at Banyuls, I have arrived at results which appear to me to be very different from what was found to be the case in the Decapod Cephalopoda.

Contrary to the opinion of M. Girod, who regards the chromatophores of the Decapoda as developing at the expense of the mesoderm, contrary, too, to the belief of M. Phisalix, who considers the pigmented cell of *Sepiola* as resulting from the fusion of a number of other cells, I hold that the chromatophore of the Octopod is of ectodermic origin, and that its accessory parts alone are mesodermic. This is tolerably comparable to what is found in the organs of sense.

In the embryo of *Argonauta* the integument consists of a simple ectodermic epithelium covering a loose mesodermic connective tissue.

In the dorsal region enclosed between the two eyes we observe, better than anywhere else, certain scattered ectodermic cells becoming larger than those surrounding them, then, little by little, sinking down into a sort of depression shaped like a funnel, dragging the neighbouring cells with them.

The tip of the projection into the subjacent mesoderm, which is thus formed, is constituted by the large cell, destined to form the essential portion of the chromatophore. Sinking still further, it at last finds itself at the bottom of a little ectodermic pit, and commences to become very large; its protoplasmic contents divide into two layers, a more solid one, which condenses round the nucleus, and another, more limpid, in which the former is immersed.

This cell, the wall of which has thickened concurrently with its expansion, finishes by being attached to the invaginated ectodermic cells by a narrow area only, and at last separates from them and becomes free in the mesoderm, a few cells of which fix themselves upon it and drive it deeper in. Henceforth it loses its spherical shape, and nearly resembles a biconvex lens.

But while this has been taking place in the ectoderm the mesodermic cells have not remained inactive. Beneath the ectodermic invagination they arrange themselves to the number of five or six in a circle; successive radical divisions then take place, and the cells are finally some twenty in number, forming a circle of greater area. In shape they are of an elongate ovoid. It is at this period that, suspended above this circle, the ectodermic cell becomes free, and there finds itself naturally enclosed; it increases in size, and by its circular rim comes in contact with this wreath of ovoid cells. The chromatophore is thus constituted. The protoplasm of the chromatic cell assumes a yellow or rose-colour, and the peripheral cells become elongated and transformed into fibres.

The muscular or connective nature of these radial fibres has been the subject of much discussion. If muscular they would, by their sudden contraction, have induced the movements of the pigmented matter; if connective, they would not have had any immediate action on these movements. According to my own observations, both of these views are nevertheless true, though in succession. The young peripheral fibres are muscular and animated by contractile movements which are most distinct, though they have no sort of action on the pigmented protoplasm; they simply cause the entire apparatus to move in the direction of the contracted fibres. It is not until later that these fibres lose their contractile quality, become similar to bundles of fibres, and serve exclusively to retain the whole chromatophore in position.

The chromatophore, then, appears to me to be formed of an essential portion, the pigmented ectodermal cell, and of accessory mesodermic parts, which primitively resemble muscular fibres, and later on become connective.

As regards the nerve-endings belonging to each chromatophore, they can be rendered visible in the living animal by means of a special preparation of methylene blue. We then see with the greatest clearness the cutaneous nervous plexus of the chromatophores, each fibre of which terminates in a slight swelling, which is applied to the chromatic cell, though it does not appear to me to penetrate it.—*Comptes Rendus*, t. cxii. no. 1 (Jan. 5, 1891), pp. 58–60.

THE ANNALS

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[SIXTH SERIES.]

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XIII.—*The Oviposition and Cocoon-weaving of* Agelena labyrinthica. By C. Warburton.

[Plate X.]

The various spinning-operations of spiders have received the close attention of many naturalists, and notably of McCook, whose important work * gives a comprehensive account of the result of observations in this field of natural history.

The subject is, however, by no means exhausted, and any contribution to the facts already collected may possess some interest.

As far as I am aware no accurate account has been published of the cocoon-weaving of *Agelena labyrinthica*, one of our largest and most abundant British species.

Every one is familiar with the sheet-like web of this spider, which is so common an object on the banks of ditches or at the foot of the hedgerows which bound our fields and country lanes. The extensive closely-woven sheet is continuous with a silken tube, in which the spider lurks, ready to rush out upon any insect which may alight upon its web.

Agelena labyrinthica is a species of spider which breeds freely in captivity. Moreover, it is not easily disturbed in its cocooning operations, which always take place by night,

* 'American Spiders and their Spinning Work,' by H. McCook.

and I was able to observe the process of egg-laying and cocoon-construction by candle-light in the case of several examples confined in glass-fronted boxes. The mode of procedure was identical in each case, and the times occupied in the several operations closely corresponded, so that an accurate account of a single observation may be considered typical of the species.

Immediately after its capture the animal had constructed its characteristic sheet-web across the box, with a tubular retreat in one corner.

The silken threads of the Agelenidæ are exceedingly fine, so that it is difficult to see the commencement of any operation, the work gradually growing into view as it proceeds; but its movements indicate that the web-spinning is begun by stretching a number of foundation-lines across the box at the level of the future sheet. The spider then walks to and fro along these lines, strewing them with numerous simultaneous threads from its long, upturned, posterior spinnerets. This operation is carried on for a long time before its result becomes at all substantial, and for long after a serviceable web has been formed the creature spends odd moments in going over the ground until its filmy appearance merges into that of an almost opaque white sheet.

In this work the advantage of the long legs characteristic of the genus is very noticeable. They appear to take the place of the extreme mobility of the abdomen which the Epeiridæ possess in giving variety of motion to the spinnerets. In *Agelena* the body is almost rigid, but is raised or depressed or moved from side to side by the action of the long legs. Thus, in strewing the fine silk of the posterior spinnerets, its gait is very peculiar. The spider takes a sinuous course, at the same time giving the posterior end of the body a wide lateral sweep, which is increased by the length and mobility of the spinnerets themselves.

The approaching oviposition was indicated several hours beforehand by the animal commencing to weave a hammock-like compartment from the roof of the box and above the sheet-like web. This chamber was about 4 inches long, and was built in precisely the same manner as the sheet, to which it was braced by lines from various points of its under surface. Its construction occupied the whole day previous to the laying of the eggs.

About midnight it was completed, and the spider, taking up its position within it, began to weave a small sheet, 1 inch long, near the roof of the cage, working diligently in an inverted position, ventral surface upwards. After a quarter

of an hour's labour it rested for an equal space, apparently exhausted by its prolonged efforts. An hour and three quarters intermittent work served to complete the sheet, the spider varying the monotony of its sinuous walk round this small area by occasionally walking over it and strengthening the lines which attached its angles to the roof.

A marked change now became observable in its manner of working. The animal abandoned its incessant to-and-fro walk, but began to jerk its body up towards the sheet, throwing silk strongly against it. At the same time the anterior spinnerets were actively rubbed together, and the long posterior spinnerets divaricated and brought together again with a scissor-like motion. The result of this performance, which lasted half an hour, was to invest the under surface of the small sheet with a coating of flossy silk quite unlike the ordinary web in texture. Its purpose soon became evident. Shortly after 2 A.M. the spider began to deposit its eggs *upwards* against this loose-textured silk, aiding the egg-mass to adhere by occasional upward jerks of the body.

The operation occupied between five and ten minutes, during which time the individual eggs were indistinguishable, but the white semi-fluid egg-mass appeared gradually to grow between the spider and the small sheet.

The oviposition accomplished, the under surface of the egg-mass was covered by a layer of flossy silk similar to that against which it was laid, the eggs being thus entirely enveloped in a coating of soft loose-textured material.

This was effected in three quarters of an hour, after which the spider resumed its customary manner of spinning, and covered in the under surface of the egg-mass with ordinary sheet-web.

The small sheet now presented with the egg-mass the appearance of a plano-convex lens, with the convex surface downwards.

About 3 o'clock the final part of the complicated structure was commenced. Carrying down perpendicular lines from the angles of the small sheet to the underlying floor of the hammock, the spider began to construct a closed box or case, with the egg-bearing sheet for its roof.

It was long before this became distinctly visible as a beautiful, filmy, transparent structure, within which the eggs were clearly to be seen, depending from its upper wall (Pl. X. fig. 6). By 9 o'clock the next morning it was of moderate strength and opacity, but labour was intermittently bestowed upon it for two or three days before it was entirely finished to the satisfaction of the spider.

When completed the animal takes up its position upon it or close at hand, and can with difficulty be frightened away, but clings to it tenaciously when interfered with.

The whole process of cocoon construction involves many hours of almost incessant work in the case of this species. The work, moreover, is very varied and perfectly regular in the sequence of its variations in the case of different individuals of the species. Of course each spider has no guide but its own instinctive urging in the performance of this complicated operation. A curious proof of its entire dependence upon instinct was furnished in the case of one spider from which the eggs were removed immediately after they had been laid. The creature nevertheless went through the whole operation, including the construction and subsequent guarding of the box or case described above, although the labour was, of course, entirely useless.

This fact recalls Fabre's remarkable experiments upon bees *. These insects construct cells, introduce a certain amount of honey and pollen, then insert the abdomen and lay an egg, and immediately afterwards seal up the orifice with a pellet of earth, which they hold in their jaws ready for the purpose during the act of oviposition. They thus secure to their larvæ a sufficiency of food, and at the same time take the utmost precaution to exclude any ichneumon or other injurious insect which might visit the cell were they to desert it for a moment after laying in order to seek material to plaster up the mouth. Nevertheless, when he made a hole in the lower part of the cell, perfectly obvious to the bee, and allowed the honey and even the egg to drop out under its very eyes, it proceeded to seal up the cell with all despatch, paying no attention to the breach which evidently nullified all its labour.

A hole made at the top of the cell it would repair, seeing, as Fabre thinks, but an imperfection in the work upon which it was then engaged; but to go back to its previous occupation of storing food, and to set right anything that might have gone wrong in that department, required an effort of recollection and reasoning quite beyond the insect's mental powers.

So the spider, in laying its eggs, bestows infinite pains in depositing them in a position of the greatest security; but when the time has come for building the cocoon the creature is absorbed in the elaborate details of its construction, and

* Fabre, 'Nouveaux Souvenirs entomologiques,' ch. x.

cannot concern itself with the question as to whether or not it happens to contain any eggs.

EXPLANATION OF PLATE X.

Fig. 1. *Agelena labyrinthica* ♀, somewhat enlarged.
Fig. 2. The spinning of the small sheet against which the eggs are deposited.
Fig. 3. The spider in the act of oviposition.
Fig. 4. The egg-mass depending from the small sheet.
Fig. 5. The same covered in with a layer of silk.
Fig. 6. The outer case of the cocoon, still transparent, and showing the silk-covered egg-mass depending from its roof.
Fig. 7. General view, showing the hammock-like compartment containing the cocoon.

XIV.—*Description of a new Vole from China.* By OLDFIELD THOMAS.

THE type of the following description was taken from the stomach of a snake (*Trimeresurus Jerdoni*, Günth.) obtained by Mr. A. E. Pratt in West Sze-chuen at the same time that he collected the fine new horseshoe bat (*Hipposiderus Pratti*) described in the June number of the 'Annals.' I propose to call it

Microtus chinensis, sp. n.

About the size of *M. ratticeps* or *M. rufocanus*, but the tail very considerably longer.

Fur very long both above and below.

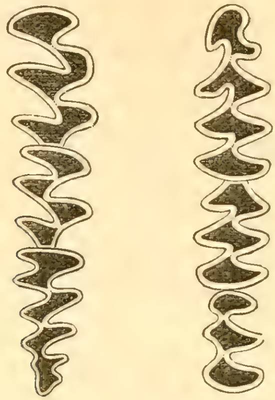
General colour dark coppery brown, not rufous, so far as can be made out from a specimen in spirit; the bases of the hairs dark slaty blue-grey.

Ears rounded, their tips just projecting beyond the fur of the head. Pollex with a distinct nail. Sole with six distinct pads, the region behind the last pad hairy, the rest quite naked. Tail unusually long, more than three times the length of the hind foot, thinly haired, the scales plainly visible, dark brown above, very slightly paler below. Mammæ 0—2=4, a formula which, combined with the presence of six foot-pads, appears to be unknown in the genus *.

Skull similar to that of *M.* (*Evotomys*) *rufocanus*, and with the peculiar structure of the posterior palatal region characteristic of *Evotomys*†.

* Lataste, Ann. Mus. Genov. (2) iv. pp. 271–274 (1887).
† See Coues, Mon. N. Am. Rod. p. 133 (1877).

Teeth (see fig.) remarkable, like those of *M. melanogaster*, M.-Edw.*, and the members of the subgenus *Evotomys*, for the fact that in several cases dentine spaces are opposite to and



Molars of *Microtus chinensis*. The inner side of each tooth-row is to the right. Magnified 8 diameters.

communicate with one another, instead of being alternate and separated. Although the specimen is fully adult, there is no sign of the formation of roots to the teeth.

The following is the molar pattern, so far as simple numeration will express its characters :—

Upper M^1, 4	spaces,	3	external and	3	internal angles.
„ M^2, 4	„	3	„	2	„ „
„ M^3, 5	„	4	„	5	„ „
Lower M^1, 7	„	4	„	5	„ „
„ M^2, 3	„	3	„	3	„ „
„ M^3, 3	„	3	„	3	„ „

In the present controversial state of our systematic knowledge of the Voles I am not prepared to say to which of the known species *M. chinensis* is most nearly related; but the number of its mammæ and foot-pads and the presence of five prominent internal angles to m^3 appear to distinguish it from all allied forms.

In some respects it seems to be annectant between *Evotomys* and the other Voles, the structure of its palate and some of its dental characters showing striking affinities to the former, far as its rootless teeth, fewer mammæ, and different external form separate it from any of the known members of that group.

* Figured by Blanford, J. A. S. B. l. pl. ii. fig. A (1881).

Dimensions of the type, an adult female in alcohol, somewhat elongated by compression in the stomach of its original collector:—

Head and body 120 millim., tail 68, hind foot 21, ear (above crown) 12; heel to front of last foot-pad 9·3; length of last foot-pad 2·2; hairy part of sole 7.

Skull: basal length 26·5, tip of nasals to back of interparietal 27; greatest breadth 16; nasals, length 9·1, breadth 3·7; interorbital breadth 4; interparietal, length 4, breadth 8·3; diastema 8; length of upper molar series 6·9; anterior palatine foramina 6.

Hab. Kia-ting-fu, West Sze-chuen (*A. E. Pratt, Esq.*).

XV.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91. By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. Alcock, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Continued from p. 34.]

Family **Macruridæ**.

Macrurus, Bl.

Subgenus Cœlorhynchus, Giorna.

24. *Macrurus quadricristatus*, sp. n.

B. 6. D. 11. A. circ. 90. P. 16. V. 7.

Head like that of *Trachyrhynchus* and much exceeding the rest of the trunk in all three dimensions; tail very low, compressed, and tapering.

The head is more than three times the rest of the trunk in length, and nearly one third the total. The depressed snout is exceedingly long and acutely triangular; its length, which is nearly half that of the head, is more than twice the major diameter of the large oval eye and twice the width of the interorbital space across the middle; six sevenths of its total

extent is preoral. The suborbital crest is strongly salient and serrated and terminates acutely at the preopercular angle. The posterior half of the head is longitudinally traversed on each side by two strongly serrated ridges, which are either bony crests or the modified spines of scales that are indetachably adherent to the bones beneath; one extends from the interorbital space to the occiput, the other from the supraorbital ridge to the shoulder.

Nostrils situated immediately in front of the eye; the posterior is very large.

The mouth is a small, completely inferior, crescentic orifice; its front limit is in the vertical through the anterior nostril, and the maxilla reaches a little behind the vertical through the middle of the eye. Villiform teeth in bands in the jaws, the outer row in the upper jaw slightly enlarged. Barbel slender, less than half the eye in length.

Gill-opening rather wide, the membranes united quite anteriorly; first gill-cleft very narrow; the gill-rakers are small tubercles; pharyngo-branchial membrane quite black.

Body and head except the glosso-hyal region covered with acutely spinigerous scales; those on the body are of one uniform size throughout, measuring rather over 2 millim. in either diameter in the specimen examined.

A scale from the head bears about three longitudinal serrate or spinate carinæ; one from the side of the body bears five slightly divergent antero-posterior ridges, which are armed with long imbricating aculeate spines, the last in each ridge projecting far beyond the edge of the scale. There are 6 or $6\frac{1}{2}$ scales in a row between the posterior limit of the first dorsal fin and the lateral line. No scaleless fossa on the nape. The first spine of the first dorsal fin is very small, the second is smooth throughout. The interval between the first and the very inconspicuous second dorsal is hardly half the extent of the base of the first. Pectorals narrow and pointed, their length slightly exceeds that of the postorbital portion of the head. Ventrals with the outer ray prolonged.

Stomach large, siphonal; many long slender cæca in a thick cluster round the pylorus; apparently no air-bladder.

Colours in life:—Chocolate; body and tail with numerous broad black cross bands, which do not reach the mid-abdominal line.

Two specimens, measuring one 7, the other 4·5 inches, from Station 115, 188 to 220 fathoms, and a third small specimen from Station 116, 405 fathoms.

Subgenus Macrurus, Bl.

25. *Macrurus nasutus*, Gthr.

Macrurus nasutus, Günther, 'Challenger' Deep-sea Fishes, p. 132, pl. xxx. fig. B.

A specimen of this Japanese form was taken in the Laccadive Sea, Station 107, at 738 fathoms.

26. *Macrurus Wood-Masoni*, Alcock.

Macrurus Wood-Masoni, Alcock, Ann. & Mag. Nat. Hist., Oct. 1890, p. 301.

A male nearly 18 inches long from Station 109, 738 fathoms.

27. *Macrurus investigatoris*, Alcock.

Macrurus investigatoris, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 391.

Numerous specimens from Station 115, 188 to 220 fathoms, and from Station 120, 240 to 276 fathoms.

28. *Macrurus semiquincunciatus*, Alcock.

Macrurus semiquincunciatus, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 392.

One specimen from Station 120, 240 to 276 fathoms.

29. *Macrurus macrolophus*, Alcock.

Macrurus macrolophus, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 394.

Two fine specimens from Station 120, 240 to 276 fathoms.

The type appears to have sustained an injury to the tail, as the relative length of the head to the body in these specimens is about 1 : 4½.

30. *Macrurus Petersonii*, sp. n.

B. 7. D. 10–11. A. circ. 135. P. 18–20. V. 8.

Length of head about one fifth total and about seven ninths of the entire head and trunk. The length of the subtrihedral snout is equal to the major diameter of the eye, slightly in excess of the width of the interorbital space, and slightly over one fourth the length of the head.

Mouth inferior, large, the maxilla reaching behind the

vertical through the middle of the orbit. Villiform teeth in a broad band in the upper and a narrow band in the lower jaw, the outer row in the upper jaw considerably enlarged. Barbel a little longer than the eye.

Gill-openings wide, the gill-membranes separate; pharyngo-branchial membrane partially pigmented.

Body and head, except the glosso-hyal region, covered with thin, imbricating, deciduous scales of uniform size, which are spinigerous except in a small area situated immediately behind the base of the first dorsal fin, where they are enlarged, circular, and quite smooth. A scale from the side of the body bears from 15 to 30 equal, distant, semierect spinelets in a shallow quincuncial arrangement. There are six rows of scales between the posterior border of the first dorsal fin and the lateral line.

The dorsal fins are separated by an interval equal to at least twice the basal extent of the first; the first spine of the first dorsal is rudimentary, the second, which is hardly prolonged, is closely and finely serrated. The anal fin begins immediately behind the vertical through the last ray of the first dorsal. Pectorals narrow, pointed; their length equals that of the postorbital portion of the head. Ventrals short, only a little longer than the barbel.

The vent is situated between the ventrals immediately behind their base, the intestine forming a wide loop behind it.

Colours in the fresh state:—Head and iris silvery; body chocolate, with an underlying silvery lustre; throat and belly black; first dorsal fin black, with white base and tip.

Two specimens (one an adult ovigerous female), 9·5 inches long, from Station 115, 188 to 220 fathoms.

I have named this species after Mr. Peterson, the gunner of the 'Investigator,' whose unabating zeal on behalf of our zoological collections led on one occasion to his getting his fingers almost amputated by the dredging-wire, and on another occasion to his falling overboard almost into the mouth of a shark.

Subgenus Mystaconurus, Gthr.

31. *Macrurus heterolepis*, Alcock.

Macrurus heterolepis, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 396.

Very numerous specimens of all sizes were taken at Station 115, 188 to 220 fathoms.

There are seven branchiostegal rays; the mouth-cleft

reaches nearly to the vertical through the posterior border of the orbit; the pectorals reach to the sixth anal ray.

Colours in life:—Head and iris silvery; body pinkish brown, with a silvery sheen; throat and abdomen black, first dorsal, ventrals, and pectorals with black base and white tips, second dorsal and anal white.

Subgenus Malacocephalus, Gthr.

32. *Macrurus lævis*, Lowe.

One specimen of this widely ranging deep-sea form was taken at Station 115, in 188 to 220 fathoms.

It measures a little more than a foot in length.

Bathygadus, Gthr.

33. *Bathygadus longifilis*, Goode & Bean.

Bathygadus longifilis, G. & B., Proc. U. S. Nat. Mus. viii. p. 599; and Günther, 'Challenger' Deep-sea Fishes, p. 157.
Hymenocephalus longifilis, Vaillant, Exp. Sci. Trav. et Talism., Poiss., pp. 218–221, pl. xxiii. fig. 1.
Bathygadus longifilis, Alcock, Ann. & Mag. Nat. Hist., Oct. 1890, p. 302.

A very fine and perfect male specimen, 13·25 inches long, was taken at Station 113, in 683 fathoms. It has the formula

B. 7. D. 12/130. P. 14. V. 8. L. lat. 150.
L. tr. 25 through vent.

The barbel is nearly two thirds the length of the head and much longer than the barbel of the large female specimen caught last year in the Laccadive Sea.

Family **Ateleopodidæ.**

Ateleopus, Schleg.

34. *Ateleopus indicus*, sp. n.

B. 8. D. 8. A.+C. 76. P. 12. V. 2.

Soft tissues almost gelatinous, skeleton cartilaginous.

Head broad and acutely conical, body and tail much compressed and tapering.

The length of the head is equal to that of the rest of the trunk and is contained about $5\frac{3}{4}$ times in the total; the

greatest height of the body, at the shoulder, is three fourths the length of the head.

The broad, depressed, projecting, marginally inflated snout is one third of the head in length and twice the major diameter of the oval eye; at least half its extent is preoral. The mouth is a small, quite inferior, crescentic orifice, in width equal to the diameter of the eye, its angle barely reaching the vertical through the anterior border of the orbit, though the maxilla reaches nearly to the vertical through the middle of the orbit; it is strongly protractile downwards, and looks as if adapted for suction. There appears to be a narrow band of very minute teeth in the inner aspect of the upper jaw; but the lower jaw is quite toothless.

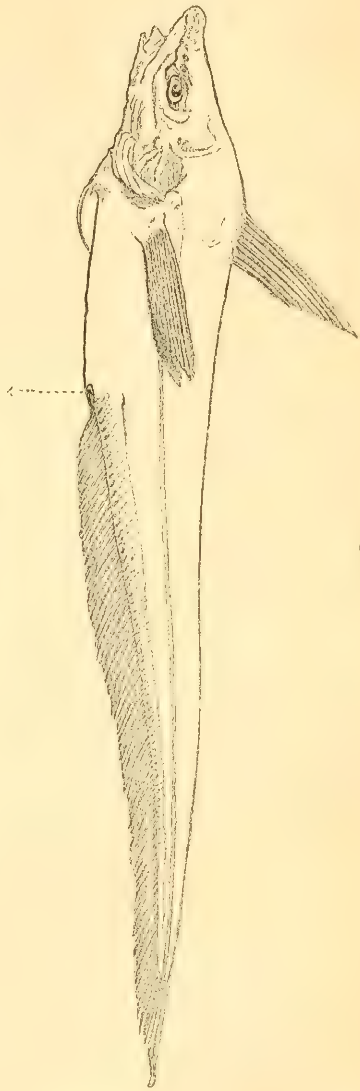


Fig. 3.

Ateleopus indicus, × $\frac{1}{3}$.

The nostrils, which are very large, are situated superiorly immediately in front of the eye.

The gill-openings are narrow, the membranes being united to the isthmus anteriorly; gill-rakers short, coarse, cartilaginous.

Head, body, and fins uniformly invested with a soft, thick, gelatinous, scaleless skin.

A single dorsal fin, the base of which is about three fourths

of a snout-length in extent, beginning almost in the vertical through the base of the pectoral; its height, which about equals the length of the latter, is six sevenths of the length of the head. The anterior rays of the anal fin are barely two thirds the body-height at their origin, the succeeding rays slightly increase in length to the confluence with the caudal; the latter is a little more than half a head-length in extent. The ventrals are jugular; each is in the form of a stiff, slightly flexible, cartilaginous rod, which is formed of two stout rays coherent throughout their whole extent, and not reaching halfway to the vent; a small detached tubercle posterior to this represents a rudimentary third ray.

Stomach long, simple; intestine short and wide; no pyloric cæca; no air-bladder.

Colours in the fresh state:—Mottled dark brown to purple-black; fins black, except the ventral.

One specimen, a foot long, from Station 115, 188 to 220 fathoms.

It will be remembered that the family Ateleopodidæ has hitherto been represented by a single species, *Ateleopus japonicus*, Schleg., from Japan. It is therefore highly interesting to find another and very closely allied species in the Bay of Bengal.

Family **Pleuronectidæ.**

Aphoristia, Kaup.

35. *Aphoristia septemstriata*, sp. n.

D. 97. A. 80. C. 12. V. 4. L. lat. 92–94.
L. tr. 40.

The length of the head is not quite one fifth, the height of the body a little more than one fourth, of the total length, without caudal. The length of the snout is about $\frac{2}{9}$ that of the head. Eyes situated almost in contact and almost between the same verticals in the anterior third of the head, their diameter being about one eighth the length of the head. On the left side is a conspicuous tubular nostril on the upper lip, and a small circular nostril in front of the interorbital space; on the right side no nostrils are visible.

Cleft of mouth slightly oblique, its angle hardly reaches behind the vertical through the anterior border of the lower orbit; small teeth on the blind side only.

Gill-openings very narrow; branchiostegal rays and membrane prolonged beyond the opercular edge.

Entire body and head, including the snout, jaws, and eyes up to the corneal margin, covered with small, adherent, ctenoid scales; no lateral line.

The dorsal fin begins above the middle of the upper eye; its longest rays, which are just in advance of the middle of the fin, are a little more than two fifths of the body-height in length and not quite so long as the corresponding anal rays. The distance from the tip of the snout to the origin of the anal fin is about equal to the body-height. The length of the caudal is contained about $7\frac{1}{2}$ times in the total. The ventrals are separated from the anal by an interval equal to the length of the snout.

Colours in the fresh state:—Left side warm brown, with seven complete rather broad cross bands.

Two specimens, nearly 4 inches long, from Station 115, 188 to 220 fathoms.

Order PHYSOSTOMI.

Family **Sternoptychidæ.**

Argyropelecus, Cocco.

36. *Argyropelecus*, sp. prox. *hemigymnus*, Cocco.

A small specimen was taken at Station 118, in 1803 fathoms; it agrees very closely with *Argyropelecus hemigymnus*, Cocco, from which it differs most conspicuously in having the luminous spots in a continuous unbroken series from the head almost to the base of the caudal; the tail also is not so abruptly constricted off from the abdomen.

This, so far as I know, is the first record of *Argyropelecus* from the Indo-Pacific.

Polyipnus, Gthr.

37. *Polyipnus spinosus*, Gthr.

Polyipnus spinosus, Gthr., 'Challenger' Deep-sea Fishes, p. 170, pl. li. fig. B.
Polyipnus spinosus, Alcock, Ann. & Mag. Nat. Hist., Nov. 1889, p. 398.

Eight fine specimens were taken at Station 115, in 188 to 220 fathoms. They have the formula

B. 6. D. 12–13. A. 15–16,

and their length ranges from 2 to 2·5 inches. The scales are quite membranous: one from the side of the trunk measures

7·5 millim. in its vertical and about 2·5 millim. in its antero-posterior diameter; one from the middle of the tail measures about 6·25 millim. in its vertical and not quite 2 millim. in its antero-posterior diameter.

GONOSTOMA, Rafinesque.

38. *Gonostoma elongatum*, Gthr.

Gonostoma elongatum, Günther, 'Challenger' Deep-sea Fishes, p. 173, pl. xlv. fig. B.

One fine mature male was taken at Station 107, in 738 fathoms. It measures 7·75 inches in length. It has the formula

D. 13. A. 30. P. 12. V. 8.

There are no scales, and the fish in the fresh state is uniformly enveloped in thick tenacious mucus. In addition to the luminous organs described by Dr. Günther there is an elliptical organ of moderate size in the middle of the posterior border of the preoperculum on each side, and one of similar shape and size on each side of the mandibular symphysis. There are six large pyloric cæca.

Colours in the fresh state:—Jet-black; luminous organs bright rose-pink, with silvery margins.

CHAULIODUS, Bl. Schn.

39. *Chauliodus Sloanii*, Bl. Schn.

Fine specimens of this well-known bathybial, or nocturnal pelagic, type were taken in the Laccadive Sea, the Andaman Sea, and the Bay of Bengal. One specimen taken at Station 109, 738 fathoms, was a mature female with the enlarged ovaries extending on each side along the entire length of the abdominal cavity, the ova being smallish (a little over half a millimetre in diameter) and very numerous.

The stomach of this specimen was deeply siphonal, the cæcal prolongation extending more than one third the length of the body-cavity. There were three moderate-sized pyloric cæca.

Family **Scopelidæ.**

HARPODON, Le Suer.

40. *Harpodon squamosus*, sp. n.

B. 17. D. 12–14. A. 13–15. P. 10. V. 9.

Tissues extremely delicate; the paired fins long, feathery, fragile.

The length of the head, measured to the edge of the operculum and not to the end of the produced branchiostegal rays and membrane, is about one fifth, the height of the body between one sixth and one seventh of the total, without the caudal. The vertex of the head with numerous mucous pores.

Snout broad, depressed; its tip is formed by the projecting lower jaw, and its length, including the mandibular element, slightly exceeds the major diameter of the eye, which is about one eighth the length of the head as above limited. The width of the flat interorbital space is twice the vertical diameter of the eye.

Mouth-cleft oblique, wide; the maxilla is nearly two thirds the length of the head as above limited. Introrsely-depressible cardiform teeth in bands in both jaws; one series in the lower jaw enlarged, with barbed hastate tips, and one series in the upper jaw less enlarged; in each palatine an outer irregularly-double row of teeth, of which the anterior and external are enlarged, and a very short inner irregularly-double row; hyoid bone and all the branchial arches toothed.

Gill-openings extremely wide; the branchiostegal rays and membrane much produced beyond the operculum.

Body, posterior part of head, and cheeks covered with deciduous cycloid scales, which are less deciduous on the posterior half of the tail.

The dorsal fin arises within the anterior half of the body (measured with the caudal) just posterior to the vertical through the base of the ventrals. The anal arises about an eye-length behind the vent, which is nearly twice as far from the gill-opening as from the base of the caudal. The fimbriated adipose dorsal is situated far back, above the posterior half of the anal. Caudal deeply forked, with an inconspicuous median lobe. Ventrals long, delicate, and feathery, the longest (middle) rays almost reach to the vent in the adult. Pectorals very narrow and fragile; they arise almost on the same plane with the eyes, and their longest (middle) rays do not quite reach to the dorsal fin.

Stomach with a very long cæcal sac; eighteen large pyloric cæca in a pectinate arrangement.

Colours in life:—Hyaline grey; paired fins and caudal black, visceral peritoneum black, buccal and branchial cavities partially and slightly pigmented.

Numerous specimens, of which several are mature females with gravid ovaries and two appear to be sexually mature males, from Station 120, 240 to 276 fathoms.

The mature females are from 9 to 10·5 inches long, the males from 7·5 to 8·5 inches long.

BATHYPTEROIS, Gthr.

41. *Bathypterois Guentheri*, Alcock.

Bathypterois Guentheri, Alcock, Ann. & Mag. Nat. Hist., Dec. 1889, p. 450.

One well-preserved specimen from Station 112, 561 fathoms.

SCOPELUS, Gthr.

42. *Scopelus engraulis*, Gthr.

Scopelus engraulis, Günther, 'Challenger' Deep-sea Fishes, p. 197, pl. li. fig. C.

Two specimens (one young, the other a mature female nearly 5·5 inches long) from Station 115, 188 to 220 fathoms.

There are seven large pyloric cæca, and an air-bladder is apparently absent.

In the young specimen, which is not quite 2·5 inches long, the diameter of the eye is still contained $4\frac{1}{2}$ times in the length of the head, and is greater than the width of the interorbital space.

NEOSCOPELUS, Johnson.

43. *Neoscopelus macrolepidotus*, Johnson.

Neoscopelus macrolepidotus, Johnson, P. Z. S. 1863, p. 44, pl. vii.
Scopelus macrolepidotus, Günther, Cat. Fish. v. p. 414, and 'Challenger' Deep-sea Fishes, p. 196.

Four fine specimens from Station 115, 188 to 220 fathoms, all sexually mature.

Colours in the fresh state:—Head, iris, sides of tongue, and belly burnished silver, dorsum of body plum-purple, flanks golden.

Family **Stomiatidæ**.

STOMIAS, Cuvier.

44. *Stomias elongatus*, sp. n.

D. 19. A. 21. P. 6. V. 6.

Body compressed, low, its height being one fifteenth of the total without the caudal; the length of the head measured from the tip of the mandible is about one tenth of the same.

Eye circular, its diameter not quite one fourth of the head-length, and equal to the width of the interorbital space.

The widely-distensible mandible projects much beyond the upper jaw. Five large, distant, fixed fangs in each premaxilla, as well as a freely movable one near the symphysis; a few minute, inconspicuous, distant denticulations in the maxillæ; eight or nine moderate-sized laterally-projecting fangs on each limb of the mandible, decreasing in size from before backwards; a fang on each side of the vomer, and two small, distant, incurved teeth on each palatine.

The barbel, which is as long as the caudal fin, is trifid at its extremity. Opercular bones membranaceous.

No scales; the body, which is coated with tenacious mucus, is mapped out into silvery hexagonal areolæ. There are on each side along the ventral surface of the body two rows of small luminous organs; the internal extends from the mandibular symphysis to the base of the caudal, but, owing to the denudation of the integuments of the tail, the number of its constituents cannot be determined beyond the origin of the anal fin, up to which point there are 57, namely, to the base of the pectorals 9, to the base of the ventrals 51, to the origin of the anal 57; the external extends from the base of the pectoral to the origin of the anal, and numbers 45. There is a single luminous organ on the barbel and a row along the base of the branchiostegal rays. The dorsal fin arises at the level of the third anal ray. Caudal pointed, its length is about one twelfth of the total. The pectorals, which arise near the ventral profile, are equal in length to the caudal. The ventrals are very long, reaching to the sixth anal ray.

Colours in the fresh state:—Jet-black, with silvery hexagonal markings.

One specimen, a little over 5 inches long, from Station 107, 738 fathoms.

Family **Clupeidæ**.

BATHYCLUPEA, gen. nov.

Head and body compressed, the former with the mucous cavities highly developed. Abdomen neither serrated nor keeled. Mouth with the lower jaw strongly prominent. Small teeth in the jaws, palatines, and vomer. Gill-openings very wide, the membranes entirely separate; 7 branchiostegals; pseudobranchiæ large. Body covered with large deciduous scales; lateral line distinct. Dorsal fin situated in the posterior half of the body, arising behind the origin of the elongate anal. Pectorals very large, entire. Ventrals small or rudimentary, *subjugular in position.* Caudal forked. Pyloric appendages in moderate number.

45. *Bathyclupea Hoskynii*, sp. n.

B. 7. D. 10. A. 33. P. 29. V. 6. L. lat. circ. 38.

Soft tissues fragile, bones thin.

Head and body compressed; the height of the latter almost exactly equals the length of the former, which is one third the total without the caudal. The median abdominal line is neither keeled nor serrated. The mucous cavities of the skull are large.

Snout rectangular, formed in front by the lower jaw, which in repose is almost vertical; its length, including the mandibular element, is not quite equal to the diameter of the large lateral circular eye, which is one third the length of the head; the width of the flat interorbital space is half the diameter of the eye. Nostrils small, almost superior.

Mouth wide, its cleft antero-lateral and nearly vertical. The upper jaw, the length of which is two thirds that of the head, has five sixths of its margin formed by the premaxillæ and one sixth by the maxillæ on each side. The last are formed of three parallel longitudinal plates, of which the posterior is slightly movable. Lower jaw excavated beneath by a deep wide mucous channel. Villiform teeth in narrow bands in the premaxillæ, mandible, and palatine, and in an inconspicuous V-shaped patch on the vomer. Tongue large, bilobed.

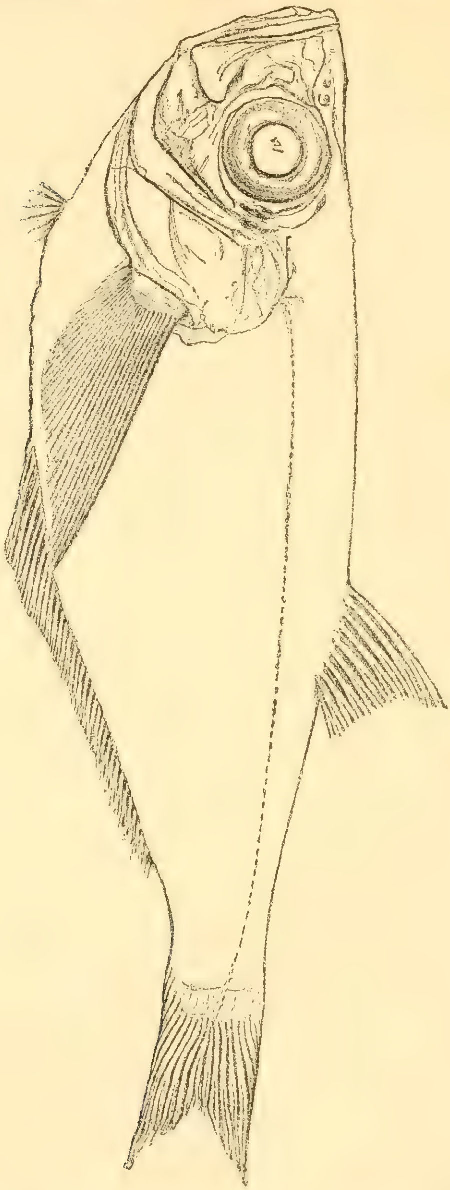
Gill-cleft very wide, the membranes entirely ununited; all the opercular bones well-developed, and the horizontal border of the preoperculum sharply serrated; four gills; the middle gill-rakers on the outer side of the first arch considerably elongated; pseudobranchiæ large.

Head naked.

Body and nape covered with large cycloid scales, deciduous everywhere except on the lateral line. In the largest specimen a scale from the flank measures 10 millim. in the vertical and 7·5 millim. in the antero-posterior diameter. Each scale of the lateral line has a deep pocket on its inner side which opens externally by numerous fine pores.

The dorsal fin commences almost exactly midway between the tip of the snout and the tip of the upper lobe of the caudal fin; the length of its base is equal to that of the snout; it is roughly triangular and its height is a fifth greater than the diameter of the eye. No adipose dorsal. The anal commences about an eye-diameter in advance of the dorsal and extends to within a very short distance (equal to three fourths of an eye-diameter) of the base of the caudal. Caudal

forked, its length about one sixth of the total. Pectorals



Bathyclupea Hoskynii.

Fig. 4.

very large and long (wing-like), extending to the twelfth

anal ray. Ventrals small or rudimentary, in close contact with one another; the short pubic bones, which are in close apposition throughout, are attached to the under surface of the clavicle above the coracoid articulation and pass downwards with such very slight obliquity that the ventral fins come to have a subjugular position.

Stomach large, with a cæcal sac and a bunch of large pyloric appendages. A large air-bladder, from which posteriorly a comparatively long pneumatic duct passes forwards and downwards to the fundus of the (distended) stomach.

Nine abdominal and twenty-two caudal vertebræ.

Colours silvery grey, becoming black on dorsum.

Four specimens (one male and three females), all sexually mature and with the reproductive glands distended, from Station 115, 188 to 220 fathoms. The male is 6·5 inches, the largest female 8 inches in length.

The stomachs of all four distended with small Penæids.

The abnormal position of the ventral fins caused me long to hesitate before bringing this fish within the Physostomous relationship, notwithstanding its unmistakable external and internal Clupeoid characters. It is to be borne in mind, however, that the ventral fins are, if not exactly rudimentary, at any rate very much degenerated organs—the degeneration of the ventrals, the shortening of the abdomen, and the conspicuous hypertrophy of the pectorals being perhaps directly interconnected changes. In this case there is nothing more remarkable in the fact of a degenerated organ having undergone a slight change in position than there is in such an organ finally disappearing, as it has in another Clupeoid, namely *Pristigaster*.

Bathyclupea is further remarkable as being the first Clupeoid reported from the deep-sea; its structural modifications are typically bathybial.

The position of *Bathyclupea* in the family Clupeidæ appears to be between the Clupeina and the Dussumieriina.

Family **Alepocephalidæ**.

ALEPOCEPHALUS, Risso.

46. *Alepocephalus bicolor*, sp. n.

B. 6. D. 21. A. 28. P. 10. V. 8. L. lat. 62.

L. tr.* $\frac{8}{9}$.

The length of the low head is a little over one fourth, the

* At level of vent.

height of the compressed body nearly one fifth the total without the caudal. The length of the obtusely-pointed depressed snout is contained about $3\frac{1}{2}$ times in that of the head. The eyes, which converge anteriorly, are between one fifth and one sixth of the head-length in diameter, and are more than their own diameter apart. The large nostrils are situated close together immediately in front of the eye.

Mouth-cleft slightly oblique; the maxilla reaches just behind the vertical through the anterior border of the orbit. A row of small teeth in each jaw and on the palatines.

Gill-openings very wide, the membranes entirely separate and overlapping broadly; a great part of the gill-cover is formed by the broad flat branchiostegal rays, which are uncovered by the opercle from their very bases; the opercular bones, which are extremely thin, are invested by the same tough black skin that covers the head; the gill-laminæ are coarse and the gill-rakers on all the arches long and lamellar; pseudobranchiæ small.

Head naked, body covered with large cycloid scales, which are deciduous everywhere but on the lateral line; small scales also invest the bases of all the fins. A scale from the flank measures about 7·5 millim. in the horizontal and about 5·5 millim. in the vertical diameter.

The dorsal and anal fins arise just in advance of the posterior third of the body (measured without the caudal), and the base of the former, which begins a little in advance of the latter, is two thirds that of the latter in extent. Caudal deeply forked, with very numerous rudimentary rays at its base. Pectorals broad, in length a little more than the postorbital portion of the head. The ventrals arise just abaft of midway between the pectorals and anal; they are broad and reach more than halfway to the anal.

Stomach small, siphonal. The intestine, which, when unravelled, is about $2\frac{1}{2}$ times the entire length of the fish, consists of two portions, which both in structure and arrangement are quite different from one another: the anterior five sixths is thin-walled and of small calibre, and is intricately coiled in a globular mass situated in the anterior fourth of the abdomen, the coils being held by a long mesentery; the posterior sixth is wide, but with walls so thick as to almost block the lumen (in the contracted state), the mucosa in this condition being thrown into numerous wide longitudinal folds; it passes straight down the middle of the abdominal cavity unsupported by mesentery. There are nine large long pyloric cæca in a pectinate arrangement.

In a female with much-enlarged ovaries containing ova

nearly 4 millim. in diameter the ovaries extend back to the wide genital pore, through which they open to the exterior.

Colours in life:—Head, including sclerotic and iris, black; body uniform dull slate-blue; pharyngo-branchial mucous membrane and parietal peritoneum black.

Note on the histology of the hind-gut.—In transverse section the appearance somewhat resembles that of the human vas deferens. Externally there is a thin fibrous coat containing blood-vessels, and internal to this and intimately adherent to it is a thin layer of longitudinally-arranged muscular fibres. Inside this is a layer, averaging about half a millimetre in thickness, of dense, circularly-arranged, muscular fibres. Internal to this is a submucous layer thrown into numerous wide longitudinal folds, and invested by a single row of long columnar epithelium, with numerous large goblet-cells. The submucous coat in all the sections made is everywhere infiltrated with round or oval, deeply-pigmented, highly granular corpuscles, which measure from $\frac{1}{1400}$ to $\frac{1}{2000}$ of an inch in diameter; in shape they resemble large leucocytes, but they are so granular that no nucleus can in any instance be detected.

The thick muscular coat, the dense infiltration of the submucosa with these pigmented granular corpuscles, and the large and numerous goblet-cells of the mucosa characterize this part of the intestine.

Several mature males and females were taken at Station 120, 240 to 276 fathoms. The males are a good deal smaller than the females, of which the largest specimen measures 11·75 inches.

Family **Murænidæ**.

Congromuræna, Kaup.

47. *Congromuræna longicauda*, Alcock.

Congromuræna longicauda, Alcock, Ann. & Mag. Nat. Hist., Dec. 1889, p. 455.

A large specimen from Station 120, 240 to 276 fathoms.

Nettastoma, Rafinesque.

48. *Nettastoma tæniola*, Alcock.

Gavialiceps tæniola, Wood-Mason, MS., Ann. & Mag. Nat. Hist., Dec. 1889, p. 460.

This species was described from immature individuals and

was included with *Gavialiceps microps* in a new genus. The examination of full-grown individuals in good preservation shows that this species has no place in the genus *Gavialiceps*, which is a true Nemichthyine form without pectoral fins, but that it ought to be ranked with *Nettastoma*. The following description applies to the adult:—

Head and snout depressed, body cylindrical, tail long and tapering. The length of the head is contained about $1\frac{2}{3}$ times in that of the rest of the trunk, the length of the tail is nearly twice that of the combined head and trunk. The snout forms a long, depressed, tapering beak, from $4\frac{1}{2}$ to $4\frac{3}{4}$ times the length of the eye and a little more than one third the length of the head; and, owing to the projection of the suddenly-expanded head of the elongated vomer beyond the abruptly ending maxillæ, it appears bilaterally notched near the tip.

There is an oval nostril situated laterally nearly midway between the eye and the tip of the snout, and in front of it a subtubular one. Mucous cavities of the head much developed and opening by large pores on the vertex, snout, and cheek.

Mouth with a wide cleft extending behind the level of the posterior border of the orbit. The upper jaw projects beyond the lower, which latter, after tapering gradually, becomes suddenly expanded near the symphysis, in the same way as does the head of the vomer. Small, sharp, close-set teeth in both jaws in several fairly regular longitudinal series, those at the mandibular symphysis enlarged and recurved; three rows of more distant teeth on the elongate limb of the vomer, those of the outer rows being inconspicuous and those of the middle row much enlarged; and a patch of small close-set teeth on the spathulate head of this bone. Tongue fleshy, fixed.

Gill-openings of moderate size, almost meeting in the mid-abdominal line; $3\frac{1}{2}$ gills.

Head and body covered with a thick, velvety, scaleless, deciduous, jet-black skin. Lateral line a row of large pores. The dorsal fin commences a little in advance of the level of the gill-opening.

Stomach with a very long cæcal sac.

Numerous sexually mature males and females nearly 2 feet in length and several young ones, from Station 120, 240 to 276 fathoms.

The young ones are silvery, with pigment only in scattered specks.

All the specimens were alive and very active on reaching the surface.

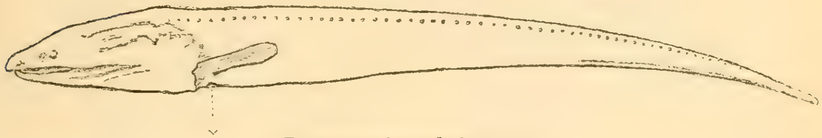
DYSOMMA, Alcock.

49. *Dysomma bucephalus*, Alcock.

Dysomma bucephalus, Alcock, Ann. & Mag. Nat. Hist., Dec. 1889, p. 459.

A single specimen from Station 120, 240 to 276 fathoms. It was alive on reaching the surface.

Fig. 5.



Dysomma bucephalus, × ½.

DYSOMMOPSIS, gen. nov.

Allied to *Dysomma*.

Tail of great relative length, the vent being close to the gill-opening. Eyes small, deeply subcutaneous. Snout studded with pores. Nostrils large, lateral. Mouth wide. Small sharp teeth in a single row in the lower and a double row in the upper jaw; a short row of enlarged teeth in the vomer. Four gills; gill-clefts wide; gill-openings small, situated close together near mid-abdominal line. Heart between the gills. Skin scaleless. Vertical fins confluent, the dorsal beginning a short distance behind the gill-opening. No pectorals.

50. *Dysommopsis muciparus*, sp. n.

Head a little inflated in the branchial region, tapering anteriorly; its length a little more than one eighth of the total. Body compressed and narrow, its greatest height, immediately behind the gill-opening, about two fifths the length of the head. The vent lies with the genital pore in an unpigmented circular depression, which is situated at a distance from the gill-opening equal to the length of the postrostral portion of the head; the tail, which tapers very slightly, is therefore more than four times the combined head and trunk in length.

Snout acutely pointed, overhanging the upper jaw; its length is one fifth that of the head and 2½ times that of the small deeply subcutaneous eye; its surface is densely crowded, like the lips, with minute pores. Nostrils large; the

anterior, which is tubular, is situated near the tip of the snout, the posterior is a valved foramen lying immediately before the angle of the eye.

Mouth wide, its cleft being nearly half the head in length; small, sharp, close-set teeth in a single row in the mandible and a double row in the maxilla; vomer with three large teeth in a longitudinal row.

Gill-openings small, close together near mid-abdominal line; the gill-covers are formed of tough skin, in which branchiostegal rays are faintly apparent; branchial arches weak, gill-laminæ broad.

Skin scaleless, enveloped in thick, very tenacious mucus. Lateral line a row of indistinct pores. Vertical fins confluent, the dorsal beginning halfway between the gill-opening and the vent, the anal immediately behind the vent. No pectoral fins.

The abdominal cavity extends almost to the tip of the tail, its posterior part being occupied solely by the genital glands and air-bladder.

Stomach with a long tapering cæcal sac reaching some distance behind the vent, and with the œsophageal and pyloric openings almost on the same level; intestine forming a single loop, the convexity of which embraces the gastric cæcum. Air-bladder a long nacreous tube extending from the occiput almost to the tip of the tail; much inflated anteriorly and tapering posteriorly to a fine thread.

Colours in life deep purple-black.

Two specimens, 9 and 10 inches long, from Station 120, 240 to 276 fathoms.

They were alive on reaching the surface.

EXPLANATION OF THE PLATES.

Plate VII.

Fig. 1. *Dibranchus nasutus.*
Fig. 2. *Dibranchus macropus*, dorsal view.
Fig. 2 *a.* Ditto, ventral view.
Fig. 2 *b.* Ditto, end-on view.
Fig. 3. *Saccogaster maculata*, ♀.

Plate VIII.

Fig. 1. *Halicmetus ruber*, dorsal view.
Fig. 1 *a.* Ditto, ventral view.
Fig. 1 *b.* Ditto, lateral view of tail.
Fig. 2. *Malthopsis luteus*, dorsal view.
Fig. 2 *a.* Ditto, ventral view.

[To be continued.]

XVI.—*On some African Butterflies hitherto referred to the Genus* Iolaus, *with Descriptions of new Species.* By Hamilton H. Druce, F.E.S.

I find that very little notice has been taken by various writers on this group of butterflies of the arrangement of the subcostal nervules. As I have been able to carefully examine nearly all the species, and find that there are considerable differences amongst them, it becomes necessary that they should be divided into several genera, which I propose to do as follows:—

Key to the Genera (formerly Iolaus).

Iolaus.

♂ ♀. Four subcostal nervules to primaries.

♂. Inner margin of primaries below with a short tuft of hair and a scaly patch over; a scaly patch near base of secondaries above. Antennæ rather long and slender.

Epamera.

♂ ♀. Four subcostal nervules to primaries.

♂. Inner margin of primaries below with a short tuft of hair; a scaly patch near base of secondaries above. Antennæ short and thick.

♀. Scaly patch very large and shining. Antennæ longer and more slender.

Sukidion.

♂. Four subcostal nervules to primaries; tuft of hair on inner margin of primaries below extending along to outer angle. No scaly patch on secondaries. Head large; antennæ long and rather stout.

Argiolaus.

♂. Five subcostal nervules to primaries; tuft of hair on inner margin of primaries below and scaly patch near base on secondaries above.

♀. Four subcostal nervules to primaries.

Tanuetheira.

Costa of fore wing much arched, outer margin rounded, tails long and broad.

♂. Five subcostal nervules to primaries; tuft of hair on inner margin of primaries below and scaly patch near base on secondaries above.

♀. Four subcostal nervules to primaries.

STUGETA.

♂ ♀. Three subcostal nervules to primaries.

♂. No secondary sexual characters.

IOLAUS, Hübn.

Iolaus, Hübn. Verz. bek. Schmett. p. 81 (1816); Westw. Gen. D. L. p. 480 (1852), part; Hew. Ill. D. L. p. 40, Supp. p. 27, part.

Hewitson (*loc. cit.*) placed *Papilio eurisus*, Cr. (=*helius*, Fabr.), as the type of this genus, and Mr. Moore has lately recharacterized it, and has agreed in making *Papilio helius*, Fabr., the type (J. A. S. B. liii. p. 34). So far as I know there are only two other species which can be placed with it, viz. *Iolaus bolissus*, Hew., from the Congo, and *I. carina*, Hew.

Iolaus helius.

Papilio helius, Fabr. Spec. Ins. ii. p. 112. n. 489 (1781).
Polyommatus helius, Godt. Enc. Méth. ix. p. 618. n. 3 (1823).
♀. *Papilio eurisus*, Cram. Pap. Exot. iii. t. ccxxi. D, E (1782).
Iolaus eurisus, Hew. Ill. D. L., Supp. t. iv. figs. 31, 32 (1869).
Iolaus helius, Moore, Journ. A. S. B. liii. p. 34 (1884).

Hab. Sierra Leone, Winnebar (*C. R. Williams*): Mus. G. & S. Lagos (*Sir A. Moloney*). Cameroon Mountains: Mus. Druce.

Sir Alfred Moloney's collections have contained a large number of this species, but I have not noted it plentiful from other localities.

Iolaus bolissus.

Iolaus bolissus, Hew. Ent. Month. Mag. x. p. 123 (1873); Ill. Diurn. Lep., Supp. p. 28, pl. iv. *a.* figs. 48, 49 (1878).

Hab. Congo (*Rogers*): Hew. Coll.

The type specimens in the British Museum and one female in Messrs. Godman and Salvin's collection are all I have seen. It is probably the southern representative of *I. helius.*

Iolaus carina.

Iolaus carina, Hew. Ent. Month. Mag. x. p. 122 (1873); Ill. D. Lep., Supp. p. 28, pl. iv. *a.* figs. 52–54 (1878).

Hab. W. Africa: Hew. Coll.

A distinct species, known to me only from the type specimens in the British Museum (Hew. Coll.). The precise locality is unfortunately not noted.

Epamera, gen. nov.

Allied to *Iolaus*; smaller. Venation the same. Fore wing below without the thick patch of scales above the tuft of hairs on the inner margin. Head broader; antennæ shorter, stouter, and less distinctly clavate.

Type *E. sidus*, Trimen.

Epamera sidus.

Iolaus sidus, Trimen, Trans. Ent. Soc. 1864, p. 176; Rhop. Afr. Aust. ii. p. 224, pl. iv. figs. 5, 6 (1866); South Afr. Butt. ii. p. 130 (1887); Hew. Ill. Diurn. Lep., p. 41, pl. xx. fig. 25 (1865).

Hab. Cape Colony, Kaffraria, Natal, Zululand, Lake Nyassa: Hew. Coll.

Mr. Trimen gives a further list of localities for this species on page 123 of his S. Afr. Butt. It seems to be a well-known South-African butterfly.

The type (♂) is in Messrs. Godman and Salvin's collection.

Epamera (?) *ceres.*

Myrina ceres, Hew. Ill. D. Lep. p. 39, pl. xvii. fig. 63 (1865).
Iolaus ceres, Trimen, S. Afr. Butt. vol. ii. p. 134 (1887).

Hab. Zululand, Delagoa Bay (*Hew.*).

I have placed this and the following species in this genus with considerable doubt, as we have no specimens for examination.

The only specimen I have seen is the one in the Hewitson Collection, which, as noted by Mr. Trimen, is in very poor condition.

Epamera (?) *mimosæ.*

Iolaus mimosæ, Trimen, Trans. Ent. Soc. 1874, p. 330, pl. ii. figs. 1, 2; S. Afr. Butt. vol. ii. p. 135 (1887).

Hab. S. Africa.

I have not seen this species, which is probably a rare one, as it is not represented in any collections to which I have access.

Mr. Trimen (*loc. cit.* p. 137) gives a long list of localities from which this insect has been obtained.

Epamera (?) *aphneoides.*

Iolaus aphneoides, Trimen, Trans. Ent. Soc. 1873, p. 110; S. Afr. Butt. vol. ii. p. 137 (1887).

Iolaus canissus, Hew. Ent. Month. Mag. x. p. 123 (1873).
Iolaus aphnæoides, Hew. Ill. D. Lep., Supp. pl. iv. *a.* figs. 50, 51 (1878).

Hab. Grahamstown (*Trimen*), Lake Nyassa (*Hew.*).

The only specimens I have seen are those in the Hewitson Collection.

a. Scaly patch near base of hind wing very large and shiny. Antennæ longer and more slender.

Epamera iasis.

Iolaus iasis, Hew. Ill. Diurn. Lep., p. 42, t. xix. figs. 11, 12 (1865).

Hab. Gambia (*G. Carter*) : Mus. G. & S. Addah : Mus. Druce. Lagos (*Sir A. Moloney*) : Mus. Druce. Cameroons, Gaboon (*G. Carter*) : Mus. G. & S.

Epamera iaspis.

Iolaus iaspis, H. H. Druce, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 30 (1890).
Iolaus jaron, Stgr., M.S.

Hab. Sierra Leone : Mus. G. & S. Addah : Mus Druce.

The type is in our collection. It is distinguished from *E. iasis*, Hew., by being of a darker blue, with greenish reflexions, and by the inner margin of primaries being blue in place of white, as in that species.

SUKIDION, gen. nov.

Allied to *Iolaus*. Costa less arched; apex more pointed, inner and outer margins straight. Underside of inner margin of primaries clothed with long black hairs from near base to apex. Secondaries circular, not produced at apex and anal angle, without any shining space on costal margin. Head broad; eyes very large; antennæ very long, with distinct elongated club. Two short linear tails, one on lower median and one on submedian nervure.

Type *S. inores*, Hew.

Sukidion inores.

Iolaus inores, Hew. Ent. Month. Mag. ix. p. 85 (1872); Ill. Diurn. Lep., Supp. p. 27, pl. iv. *a.* figs. 44, 45 (1878).

Hab. Gaboon (?).

The type specimen is now in Messrs. Godman and Salvin's

collection, and is the only one I have seen. Notwithstanding that Hewitson states that Mr. Druce was unable to ascertain its habitat, it has a written label "Gaboon," whence I think there is not much doubt that it came.

Argiolaus, gen. nov.

Allied to *Iolaus*, but with an additional subcostal nervule in male bifurcating from the fourth near the apex; female with four subcostal nervules. Antennæ thicker and more gradually clavate. Terminal joint of palpi shorter.

Type *A. silas*, Westw.

a. ♂ ♀. More or less blue on upperside.

Argiolaus silas.

Iolaus silas, Westw. Gen. D. L. p. 481, pl. lxxiv. fig. 5 (1852).
Thecla nega, Herr.-Schäff. Ex. Schmett. figs. 51, 52 (1853 ?).
Iolaus silas, Trimen, Rhop. Afr. Austr. ii. p. 222. n. 128 (1866); S. Afr. Butt. ii. p. 127 (1887).

Hab. Cape Colony, Kaffraria, Natal, Zululand, Transvaal (*F. S. Barrett*): Mus. G. & S. Panmure.

Mr. Trimen (S. Afr. Butt. p. 129) gives a long list of localities for this species.

Argiolaus silarus.

Iolaus silarus, H. H. Druce, Ent. Month. Mag. xxii. p. 154 (1885).

Hab. Momboia, East Central Africa (*Last*): Mus. G. & S. Delagoa Bay (*Mrs. Monteiro*).

This species appears to take the place of *A. silas* in East Africa. The upper crimson spot in hind wing of female is wanting in all the specimens I have seen. It is the var. A of Mr. Trimen (S. Afr. Butt. ii. p. 128) and is not allied to *I. iulus*, Hew., as stated on p. 154, Ent. Month. Mag. xxii.

Argiolaus silanus.

Iolaus silanus, Smith, Ann. & Mag. Nat. Hist. ser. 6, vol. iii. p. 137 (1889).

Hab. Mombosa (*Last*): Mus. H. G. Smith.

This species is unknown to me.

Argiolaus Trimeni.

Iolaus Trimeni, Wallgr. Œfv. K. Vet.-Akad. Förh. p. 87 (1875); Trimen, S. Afr. Butt. ii. p. 129, pl. vii. fig. 4 (1887).

Hab. Transvaal.

I have not seen this species. Judging from Mr. Trimen's figure it is perfectly distinct.

Argiolaus lukabas.

Iolaus lukabas, H. H. Druce, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 30 (1890).

Hab. Gambia (*Sir A. Moloney*) : Mus. Druce.

The type specimen is the only one I have seen. It is apparently allied to *A. Trimeni*, but has a row of four distinct black spots on the outer margin of hind wing above, and is without the black and yellow lines on the underside.

Argiolaus lekanion, sp. n.

♂. Allied to *A. lukabas*, mihi. Upperside purer and rather darker blue; fore wing with the apex and outer margin more broadly black; hind wing with the shining patch and the anal fold darker and with the blue extending to the outer margin, and without the black spots; lobe orange. Underside as in *A. lukabas*, but the orange spot on hind wing between the median nervules large and distinct. The patch of hairs on underside of primaries as in *A. lukabas*.

Abdomen black above, white below; legs white; palpi black above, white below. Antennæ black.

Expanse $1\frac{17}{20}$ inch.

Hab. Sierra Leone: Mus. Druce.

We have two males of this species which do not differ and can at once be separated from the allied species.

Argiolaus iulus.

Iolaus iulus, Hew. Ill. Diurn. Lep., Supp. p. 9, pl. iv. figs. 41–43 (1869).
Iolaus iulus, var., C. Oberthür, Etudes d'Ent. iii. p. 22 (1878).

Hab. Sierra Leone: Muss. G. & S. and Druce. Sherborough Island: Hew. Coll. Zanzibar (*Oberthür*).

We have two males from Sierra Leone which are identical with Hewitson's type in the British Museum; but in a female in Messrs. Godman and Salvin's collection the red on the hind wing is replaced by pale yellow on both surfaces. It is

the most brilliantly coloured species of the group, and Hewitson's figure does not do it justice. It is, I think, doubtful whether the insect referred to by M. Oberthür can be placed under this name.

Argiolaus Jamesoni, sp. n.

Iolaus iulus, Godm. & Salv. in Mrs. Jameson's Story of Rear Column, p. 442 (1890).

♂. Allied to *A. iulus*, Hew. Upperside paler and less brilliant blue; primaries distinctly whitish at base of the costa: secondaries, cilia pure white; a dark red spot, below which is a small black one occupying the upper half of the lobe, the lower part being white, with a narrow black line at the margin; tails pure white, with a narrow black central line. Underside creamy white; primaries with costal margin and apex slightly fulvous ochreous: secondaries with a well-marked orange band, thickening slightly at each nervule, running from the apex to the anal angle, where it converges into the usual anal reddish-orange patch, and connected with a patch of the same yellow (having a black spot in centre) between the lower median nervules; a narrow broken zigzag line running from near the apex inside the yellow band and reaching to the inner margin, where it is rather more distinct; a deep black spot, with a few blue scales under, in the lobe, and on the anal orange patch are a few pale lavender scales. A narrow black marginal line from the apex to the anal angle and down the centre of the tails; cilia white.

Head white; thorax greyish; palpi white below, black above, and black-tipped; legs white; antennæ black, spotted with white beneath.

Expanse 2 inches.

Hab. Yambuya Camp, Aruwimi River (*J. S. Jameson*): Mus. G. & S.

This is evidently a distinct species from *A. iulus*, Hew., to which it was referred by Messrs. Godman and Salvin in the list of butterflies collected by the late Mr. Jameson ('Story of the Rear Column,' p. 442, 1890). It is a different shade of blue. The specimen has a label attached, "Yambuya Camp, Jameson."

Argiolaus mœsa.

Myrina mœsa, Hew. Ill. D. Lep. p. 27, pl. xi. fig. 45 (1863).

Hab. Sierra Leone.

I am not certain that this species is correctly placed here.

Hewitson states that the type is a male, but his figure has much the appearance of a female, and a specimen in the Hewitson Collection labelled *mœsa* is almost certainly a female, and seems allied to that sex of *A. iulus*. The specimen in the British Museum is in very poor condition.

Argiolaus alcibiades.

Iolaus alcibiades, Kirby, Syn. Cat. p. 409 (1871).
Papilio timon, Don. (nec Fabr.), Nat. Rep. iii. t. xcvii. (1825).

Hab. Sierra Leone: Mus. Druce. Lagos (*Sir A. Moloney*). West Coast: Mus. G. & S.

It is with considerable doubt that I refer the specimens before me to this species. Two females, one labelled West Coast of Africa, in Messrs. Godman and Salvin's collection, and one lately brought home by Sir Alfred Moloney from Lagos, which undoubtedly represent the same species, agree well with Donovan's figure on the underside, but on the upperside the blue is much paler, and they have the usual orange spot on the lobe, which is not shown in the figure; the blue also on the hind wing does not reach below the black spots as shown in the figure. In two males which are undoubtedly referable to the females noted above the lobe only is orange-red, the shiny patches are greenish brown and large, and on the underside the red bands on both wings have almost entirely disappeared, leaving only the faint black line and the prominent orange spots near the anal angle of hind wing.

It will be noted that no trace of any shining patch is shown in Donovan's figure.

The hairs attached to underside of inner margin of primaries are black.

Argiolaus paneperata.

Iolaus paneperata, H. H. Druce, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 30 (1890).

Hab. Lagos (*Sir A. Moloney*): Mus. Druce.

A distinct species, somewhat like *A. silas*, Hew., on the upperside, but very different beneath. The patch of hairs on fore wing below is black in this species, yellow in *A. silas*.

Argiolaus laon.

Iolaus laon, Hew. Ill. Diurn. Lep., Supp. p. 28, pl. iv. *a.* figs. 46, 47 (1878).

Hab. Sierra Leone: Mus. Druce. Gold Coast.

The type specimen (♀) is now in Messrs. Godman and Salvin's collection.

♂. On the upperside a darker and richer blue, with the borders much blacker and the hind wing without the inner black patch near the anal angle. The shining patch on hind wing is large, black, and with a large buff central spot. On the underside it differs from the female by having the inner marginal area of fore wing black, powdered with white scales, and extending up to the wall of the cell and along the lower median nervule almost to the margin.

The hairs on underside of fore wing are deep black.

Argiolaus glaucus.

Iolaus glaucus, Butl. P. Z. S. 1885, p. 766.

Hab. Somali-land.

Argiolaus Belli.

Iolaus belli, Hew. Ill. Diurn. Lep., Supp. p. 9, pl. iv. figs. 33, 34 (1869).

Hab. Sherborough Island (*Hew.*). W. Africa: Mus. G. & S.

I have not seen the male of this insect.

Argiolaus cyteis.

Iolaus cytæis, Hew. Ent. Month. Mag. xi. p. 182 (1875).
Iolaus cyteis, Hew. Ill. Diurn. Lep., Supp. p. 29, pl. iv. *a.* figs. 55, 56 (1878).

Hab. Fernando Po (*Hew.*).

The female of this species does not seem to have been described.

b. ♂ green on upperside, ♀ greyish white.

Argiolaus calisto.

Anthene calisto, Doubl. & Hew. Gen. D. Lep. t. lxxv. fig. 6, ♂ (1852).
Iolaus calisto, Hew. Ill. D. Lep. p. 41 (1865).

Hab. Gambia: Mus. Druce. Sierra Leone, Gaboon (*J. Carter*): Mus. G. & S.

The female, which has not been described, is somewhat larger than the male and is greyish white, with the costa, apex, and outer margin of fore wing and apex of hind wing blackish brown. Hind wing with an ultramedian, somewhat irregular, brown band reaching from the apical patch to the

anal margin above the lobe; beyond this a less distinct submarginal band and a broad, dark brown, marginal band. Lobe reddish orange, with a black spot and an orange spot just above the submedian nervure.

Both wings slightly suffused with bluish-grey scales at the base; cilia of fore wing brown, of hind wing pure white. Underside as in the male.

Although this species has been described some years, it is not common.

c. ♂ blue on upperside, ♀ white.

Argiolaus menas.

Iolaus menas, H. H. Druce, Ann. & Mag. Nat. Hist. ser. 6, vol. v. p. 29 (1890).

Hab. Gambia: Mus. Druce. Gaboon (*G. Carter*): Mus. G. & S.

The two males in Messrs. Godman and Salvin's collection from Gaboon are of a somewhat more violaceous blue than the type and have some white scales on the bases of the median nervules of the primaries.

d. ♂ ♀ white on upperside.

Argiolaus ismenias.

Lycæna ismenias, Klug, Symb. Phys. p. 40, figs. 1, 2 (1834).

Hab. Ambukohl (*Klug*). Lagos: Mus. Druce.

Sir A. Moloney's collections contained a considerable number of this species; but I have not seen it from any other locality. It is perhaps the most remarkable of the genus, both sexes being alike in coloration.

TANUETHEIRA, gen. nov.

Allied to *Argiolaus*, male having five subcostal nervules, female four. Costa of primaries more arched, outer margin rounded. Secondaries with three distinct tails, the third being much longer and broader than in *Argiolaus*. Lobe scarcely developed and without the usual red spot. Antennæ moderately long and slender, much as in *Iolaus*.

Type *T. timon*, Fabr.

Tanuetheira timon.

Papilio timon, Fabr. Mant. Ins. ii. p. 65 (1787).
Iolaus timon, Doubl. & Hew. Gen. D. Lep. p. 481 (1852).

Myrina timon, Butl. Cat. Fab. p. 184 (1870); Lep. Exot. p. 42, t. xiv. figs. 3, 4 (1870).
Iolaus timon, Hew. Ill. Diurn. Lep., Supp. pp. 10, 29, pl. iv. *a*. fig. 57, ♂ (1878).

Hab. Sierra Leone, Old Calabar: Muss. G. & S. and D.

There seems to have been a good deal of doubt about the identification of this insect until Mr. Butler procured a drawing of the type, which he figures. Hewitson afterwards figured the male.

Tanuetheira prometheus, sp. n.

♂. Allied to *T. timon*, Fabr., from which it differs by having a large bronze-brown, shining, discal spot on the fore wing above and by the shining patch on hind wing being larger.

♀ scarcely distinguishable from that sex of *T. timon*, but with somewhat less black at the anal angle of hind wing above.

Expanse, ♂ $1\frac{4}{5}$ to $2\frac{1}{5}$ inches, ♀ 2 inches.

Hab. Sierra Leone: type Mus. Druce.

A distinct species, easily recognized by the bronze discal spot on the primaries. We have two males in our own collection, and there is one in Messrs. Godman and Salvin's, which do not vary except in size.

Stugeta, gen. nov.

Allied to *Tajuria*, Moore, but differs by having three subcostal nervules only in both sexes in place of four, as in that genus, and by the apex and outer margin of primaries being somewhat more rounded. No secondary sexual characters.

Type *S. Bowkeri*, Trimen.

Stugeta Bowkeri.

Iolaus Bowkeri, Trimen, Trans. Ent. Soc. 3rd ser. ii. p. 176 (1864); Rhop. Afr. Austr. ii. p. 225, pl. iv. fig. 4 (1866); S. Afr. Butt. vol. ii. p. 132 (1887); P. Z. S. 1891, p. 85; Hew. Ill. D. Lep. p. 41 (1865).

Hab. Congo (*Butler*), Momboia (*Last*): Mus. G. & S. Cape Colony, Kaffraria, Natal (*Trimen*).

Mr. Trimen gives (*loc. cit.* p. 134) a list of localities in S. Africa where this species has been captured.

Stugeta marmoreus.

Aphnæus? marmoreus, Butl. Ent. Month. Mag. ii. p. 169 (1866).
Iolaus marmoreus, Hew. Ill. D. Lep., Supp. p. 11 (1869).

Hab. White Nile.

The only specimen I have seen is the type in the British Museum. It appears distinct from the preceding.

I have not included in the present paper several species which have been either described or placed in the genus *Iolaus* by various authors, as they do not seem to me to be properly referable to any genera noted here, *i. e.*:—

Myrina pallene, Wallengr., placed in *Iolaus* by Mr. Trimen.
Iolaus argentarius, Butler, from Madagascar.
Iolaus piaggiæ, Oberthür, from Abyssinia.
Iolaus tajoraca, Walker, from Arabia.

XVII.—*On the* Phasmidæ *of Madagascar, with the Description of a new Genus and Species in the Collection of the British Museum.* By W. F. Kirby, Assistant in Zoological Department, British Museum (Natural History).

We are constantly being reminded of the incompleteness of our knowledge as regards entomology, and sometimes even in the case of the largest and most conspicuous insects of countries which have frequently been visited by collectors; but I was hardly prepared to find that practically nothing is yet known of the Phasmidæ of Madagascar.

The four following species, all belonging to genera peculiar to the island, are literally all which have been described as inhabiting it:—

(1) *Acroioptera fallax*, Coq. Ann. Soc. Ent. France, (4) i. p. 495 (1861). Port Leven.

(2) *Parectatosoma hystrix*, Wood-Mason, Journ. As. Soc. Beng. xlviii. p. 117 (1879). Fianarantsoa, Antananarivo.

(3) *P. echinus*, Wood-Mason, *l. c.* p. 118 (1879). Fianarantsoa.

(4) *Orobia nigrolineata*, Stål, Svensk. Handl. Bihang, ii. (17) p. 17 (1875). Madagascar.

They are all very spiny (except *Orobia*), and all exhibit strong Australian affinities.

In our present ignorance of what other species may occur in Madagascar it is useless to add further generalities; but I have much pleasure in appending the description of a fifth species, an exceedingly large and beautiful insect.

Genus Enetia, gen. nov.

Female.—Allied to *Acrophylla*, but with the head and pronotum spined above; wings not longer than broad; ovipositor boat-shaped, extending considerably beyond the abdomen.

Enetia spinosissima, sp. n.

Head and pronotum of nearly equal length; ocelli not visible; antennæ at least 22-jointed (possibly not quite complete), scape very broad, second joint rather longer than broad, third longer and slenderer, fourth transverse, fifth and sixth equally long, rather shorter than the third, the remainder gradually increasing in length. Head green in front, paler behind, with seven white longitudinal lines, the two on each side of the median line each set with three red, black-tipped spines; there is also a small one on each side of the hinder and slightly bifid extremity of the slender median line. Pronotum pale olive-green, like the back of the head, with some broad suffused whitish streaks and nine rather irregularly placed spines. Pronotum green, above darkest, and whitish behind, and covered all over with red, black-tipped spines. Metanotum varied with greenish and very pale pink above and green below; under surface very spiny. Abdomen mahogany-brown, the median line beneath bordered with numerous concolorous spines, arranged in pairs; anal styles very short, almost spinose; oviduct green, boat-shaped, the part extending beyond the abdomen as long as the last two abdominal segments together. Legs green, with rows of small white spots and dots, the spines on the femora mostly yellow, tipped with black, and those on the tibiæ mostly green. Front legs strongly channelled, femora strongly spined below, and the upper and outer carina serrate-spinose. Front tibiæ with the outer carina much undulated, but hardly forming distinct laminæ. Middle and hind femora and tibiæ with a double row of strong spines beneath, and the femora with a double row of smaller spines above; upper carina of middle tibiæ waved. Tegmina brown, with yellowish nervures, and a white stripe at the base of the costa, which

afterwards diverges from it and ends in a point at two thirds of the length. Costal area of wings rather broad, red, with paler nervures, and a broad, white, subcostal stripe, which soon becomes fainter and gradually disappears. Lower portion of the wing blackish, slightly subhyaline, with black cross-nervures and numerous pale green spots arranged in irregular transverse bands; the marginal band is regular and of a darker green.

Length of body 238 millim., head 10, pronotum 11, mesonotum 39, metanotum 13, abdomen 150; projecting part of oviduct 15; tegmina 20; wings 54; fore femur 29, tibia 26; intermediate femur 30, tibia 25; posterior femur 42, tibia 36; antennæ 54.

Collected by Mr. T. Last at Mourondava, South-west Madagascar.

XVIII.—*Descriptions of some new Species of Chilopoda.* By R. I. Pocock.

The types of the species described in the following paper, from various scattered localities, are preserved in the British Museum of Natural History.

Lithobiidæ.

Lithobius (s. s.) *provocator*, sp. n.

Colour ochraceous or pale castaneous, anteriorly deeper castaneous; legs paler.

Body very robust, nearly parallel-sided, posteriorly attenuated.

Head wider than long, very convex.

Maxillary teeth 5 + 5 or 6 + 6, conspicuous, (4 + 4 in young).

Antennæ moderately long, sparsely hirsute at the base, thickly hirsute distally, composed of from 42–51 segments (young with 34 segments).

Eyes composed of about 19 ocelli, arranged as follows—1 + 5, 4 or 5, 4 or 5, 4 or 5.

Tergites in the posterior half of the body subgranular; the angles of the ninth, eleventh, and thirteenth moderately produced.

Sternites sparsely hirsute, impressed.

Legs.—First pair armed beneath as follows:—0, 0, 2, 2, 1; anal legs moderately robust and moderately long, claw un-

armed, armed beneath as follows—0, 1, 3, 3, 1; coxæ of the three posterior pairs armed with a conspicuous lateral spine; coxal pores in the adult elongate, arranged in a single series as follows—8, 8, 8, 7 or 6 (in the young the pores are rounder and 5, 5, 5, 4).

Generative forceps in female with two spurs on each side and a trifid claw.

Length up to 29 millim.

Four specimens from Bermuda ('*Challenger*').

This species is evidently allied to *forficatus*, but it differs at least in having the three posterior coxæ armed with a lateral spine.

Lithobius (s. s.) *sydneyensis*, sp. n.

Colour * ochraceous.

Eyes composed of about 10–15 ocelli, arranged in three or four rows approximately as follows—1+5 or 4, 5 or 4, 4 or 3.

Antennæ moderately long, hairy, composed of 26–28 segments.

Maxillary coxæ mesially impressed, with 2+2 conspicuous teeth, excised in the middle line.

Tergites more or less wrinkled, in the posterior half of the body distinctly granular; angles of the ninth, eleventh, and thirteenth strongly produced.

Sternites sparsely hairy, not mesially impressed.

Legs hairy and spinous; the first pair armed below as follows—0, 0, 1, 3, 1; anal legs robust, only a little longer than those of the preceding somite, armed beneath as follows —0, 1, 3, 3 or 2, 1; coxa without a lateral spine; upper surface of the patella of the male furnished at its distal end with a nodular projection, which is hollowed out above; coxæ of the four last legs furnished (in the adult) with 6, 7, 7, 5 elongate pores, arranged in a single series.

Generative forceps of the female with two long spurs on each side and a slender, lightly bifid claw.

Length 19 millim.

Four specimens (1 ♀, 3 ♂) from Sydney, presented by Mr. John Brazier.

I believe this to be the first species of the genus recorded from Australia. Dr. Newport described one species named *argus* † from New Zealand; but *L. sydneyensis* is very

* Possibly faded from long immersion in spirit.

† The type of *L. argus*, which is preserved in the Hope Museum at Oxford under the name *zelandicus*, shows that the species is referable to *Lithobius sensu stricto.* More than this I was not able to determine in the hurried examination that I was able to give the specimens.

distinct from it in the number of its eyes and maxillary teeth.

Henicops insignis, sp. n.

Colour deep ochraceous, closely mottled with darker patches; antennæ, tarsi of legs, and maxillipedes pale ochraceous.

Body robust, narrower in its anterior half.

Head superiorly impressed, frontal plate distinct.

Antennæ long, pubescent, composed of 46 segments, of which the apical is much longer than the penultimate.

Maxillary coxæ with a median longitudinal impression; anterior border produced, deeply excised in the middle line, with two small teeth on each side.

Tergites sparsely hairy and sparsely granular, lightly wrinkled, with raised margins, the ninth, eleventh, and thirteenth with straight posterior borders.

Sternites lightly impressed on each side.

Legs armed with setæ, the *tibiæ*, except those of the last three pairs, with their external distal margin produced into a strong spine-tipped tooth; the legs increasing in length from before backwards; the anal legs very long, considerably more than half the length of the body, the tibia and first tarsal segments the longest.

Coxal pores conspicuous, round, 4, 4, 4, 4.

Generative forceps of the female without basal spurs; claw simple, obtuse.

Length 19 millim.

Two specimens (♂ ♀) from Juan Fernandez ('*Challenger*').

This species differs from *chilensis* of Gervais—assuming the figure of the last-named to be trustworthy—in having much longer antennæ, these appendages in *chilensis* being composed of less than 20 segments; moreover, the anal legs of *chilensis* are very much shorter and the femur appears to be spined.

Henicops emarginatus of Newport, from New Zealand, resembles *H. insignis* in having the posterior borders of the tergites straight and the angles rounded; but it has only about 26 antennal segments.

H. maculatus of Newport (= *H. impressus*, Hutton, Ann. & Mag. Nat. Hist. (4) xx. p. 115), found in Tasmania and New Zealand, has from 36–38 antennal segments, 6 (according to Hutton 8) maxillary teeth, the posterior borders of the ninth, eleventh, and thirteenth tergites deeply emarginate, and the anal legs very long, the proximal metatarsal segment being composed of two and the distal of four segments; the coxal

pores are rounded, arranged in a single series, and 5 or 4 in number.

H. insularis of Haase, from Auckland, is very different from all the species here mentioned in having very short anal legs and only a single pore in each of the posterior coxæ.

Scolopendridæ.

Cryptops atlantis, sp. n.

Colour.—Antennæ, head, first two and last two somites, and anal legs clear ochraceous; rest of the legs testaceous; rest of the somites ochraceo-fuscous.

Antennæ (? 15-jointed).—Basal segments short and beset with bristles, the rest of the segments longer, pubescent, and scarcely hirsute.

Head-plate not sulcate, its posterior border overlapped by the first tergite.

Maxillary coxæ with anterior border slightly thickened and slightly and angularly excavated in the middle line and furnished on each side with about four bristles; femora and claws of normal form.

Tergites.—The first three wholly without sulci, the fourth obsoletely sulcate posteriorly and laterally, the rest (except the last) with four sulci, two internal complete and longitudinal, two external incomplete and oblique; the oblique sulci almost obsolete on the seventeenth to twentieth tergites; tergites smooth and shining, very obscurely punctate and hairy, with simple unraised margins.

Sternites lightly punctured and hairy, all (except the last) medianly and longitudinally sulcate, the transverse sulcus scarcely perceptible.

Anal somite.—*Tergite* with raised margins, not sulcate, lightly depressed posteriorly; *pleuræ* furnished in front and below with many pores, smooth above and behind, with rounded, hirsute, postero-inferior angle; *sternite* shorter than the pleuræ, with converging lateral margins, rounded lateral angles, and lightly concave posterior border; *legs*—*femur* smooth above, the sides furnished below with short spiniform hairs, the lower surface thickly beset at the sides with short spiniform hairs, smooth and longitudinally excavated in the middle; *patella* slightly thicker and slightly shorter than the femur and much less spinous, the inferior surface furnished laterally with smaller and fewer spiniform hairs, which are interspersed with many long bristles; *tibia* much shorter than the patella, lower surface deeply excavated

anteriorly, swollen, convex, and very hairy posteriorly, its inner surface very flat, its inferior edge being furnished throughout its length with fifteen very minute close-set denticles; *first tarsal segment* a little shorter than the tibia and more slender, but closely resembling it in shape; there are, however, fewer hairs on its lower surface and the inferior edge of the inner surface is furnished in front with six much larger denticles; *second tarsal segment* longer than the first and slender, its inferior surface deeply excavated anteriorly and carinate posteriorly; *claw* simple.

Legs long and hairy, the twentieth pair longer and stouter than the preceding pairs.

Length 21·5 millim.

A single specimen from Madeira, collected by my friend and colleague Mr. W. R. Ogilvie-Grant.

This species is closely allied to the common European *Cr. hortensis*, but appears to differ in the armature of the anal legs. Thus on the tibial segment the spines are very much smaller than on the first tarsal and are fifteen in number, whereas in *hortensis* these spines are approximately as large as on the first tarsal and vary in number up to ten. Moreover I have never seen a specimen of *hortensis* with anal legs of the shape that this species exhibits; in this particular *Cr. atlantis* approaches *Cr. cultratus* of C. Koch. This last, however, may be at once recognized by its sulcate head-plate &c.

Cryptops spinipes, sp. n.

Colour ochraceous.

Body slender, punctured and hairy.

Head marked with two very fine anteriorly diverging sulci.

Antennæ attenuate, hairy throughout, composed of 17 stout segments.

The *first tergite* marked in front with a transverse evenly arched sulcus; not distinctly sulcate longitudinally; overlapping or overlapped by the head.

Maxillary coxæ with anterior border angularly excised in the middle and furnished on each side with about five setæ.

Tergites (except the first three and the last two) marked with the four normal sulci, all (except the last) with unraised margins.

Sternites (except the first and the last three) marked with an anterior longitudinal sulcus and a complete transverse sulcus, the posterior limb of the normal cross-shaped mark being very indistinctly defined.

Anal somite.—*Tergite* and *sternite* of normal form; the *pleuræ* furnished below and in front with a number (about thirty) of larger and smaller pores, posteriorly smooth and armed with stout spiniform hairs. *Legs*: *femur* and *patella* armed beneath (except in the middle) and internally with subserially arranged spines, superior posterior angles slightly produced; *tibia* much shorter than the patella, armed above and behind with two sharp spines, beneath with a row of about eight short tooth-like spines; *first tarsal segment* armed below with a row of about three tooth-like spines; *second tarsal segment* carinate in its posterior two thirds.

Legs, especially at the posterior end of the body, armed with stout spiniform hairs.

Length 24 millim.

Two specimens from Sydney, presented by Mr. John Brazier.

This species is very closely allied to *Cr. sulcata* of Haase, but differs in that the longitudinal dorsal sulci are not visible on the first and second tergites, but take their origin from the hinder half of the third.

In *sulcata*, which is also an Australian species, these sulci are complete on the first, second, and third tergites.

Cryptops setosus, sp. n.

Colour ochraceous.

Body robust, thickly and coarsely punctured throughout, and hairy.

Head marked throughout by two fine anteriorly diverging sulci.

Antennæ short, hairy throughout, composed of 17 stout segments.

First tergite covered in front by the head, marked anteriorly by a strong transverse sulcus, not longitudinally sulcate.

Maxillary coxæ with lightly convex, mesially excavated, anterior border, furnished on each side with about four setæ; claws long and slender.

Tergites (except the first three and the last two) quadrisulcate, the lateral sulci beginning at the second, the nineteenth tergite with lateral sulci, but with very short median sulci; all the tergites except the last with unraised margins.

Sternites marked with a cross-shaped sulcus, the longitudinal sulcus, however, being nearly obsolete behind and abbreviated in front.

Anal somite.—*Tergite* and *sternite* of normal form; *pleuræ*

furnished with many (50 +) larger and smaller pores, scarcely spinous behind; *legs* absent.

Legs hairy, spinous beneath, the twentieth pair larger than the nineteenth.

Stigmata elongate and ovate, in the anterior half of the body more slit-like than in the posterior half.

Length 34 millim.

A single specimen from New Zealand, presented by Mr. F. E. Beddard.

Closely allied to the preceding species, but much larger, much more hairy, and more coarsely and closely punctured.

Cryptops capivaræ, sp. n.

Colour pale ochraceo-olivaceous; head ochraceous.

Body nearly smooth, obsoletely punctured, and sparsely hairy.

Head marked throughout its length by two very fine anteriorly diverging sulci.

Antennæ stout, attenuate, pubescent throughout, basally hirsute; apical segment ovate and not longer than the penultimate.

Maxillary coxæ with anterior margin moderately arcuate, angularly excised in the middle, furnished with six setæ on each side.

Tergites.—The first covering the head behind, entire, the second without sulci, the third faintly bisulcate; from the fourth to the nineteenth quadrisulcate, the twentieth faintly bisulcate; all except the anal tergite with simple margins.

Sternites in the anterior half of the body marked with a cross-shaped sulcus; posteriorly the posterior bar of the cross disappears, the last three sternites not sulcate.

Anal somite.—*Tergite* of normal form; *pleuræ* rounded, but not spinous posteriorly, furnished with many (30 +) larger and smaller round pores; *sternite* wide, nearly quadrate, parallel-sided, with rounded posterior angles and straight posterior border. *Legs*: the *femur* and *patella* very sparsely spinous below and on the inner surface, the upper surface of each marked throughout its posterior half by a median longitudinal groove; *tibia* not sulcate above, but with its posterior edge biangulate above, sparsely hairy beneath, and furnished with a row of about eleven small denticles; first tarsal segment biangulate like the tibia, excavated beneath in front, armed with about three denticles; second tarsal segment excavated beneath in front, carinate in its posterior three quarters.

Legs armed with hairs and hair-like bristles.

Length 24 millim.

A single specimen from Rio Capivari (Brazil), collected by Michaelis.

Apparently allied to *Cr. galatheæ* of Meinert, from Monte Video. In *galatheæ,* however, the anal sternite is said to be "*manifesto attenuata,*" whereas in *Cr. capivaræ* it is nearly square. Moreover, Dr. Meinert makes no mention of the sulci on the head-plate nor of the conspicuous grooves on the femur and patella of the anal legs.

Otocryptops punctatus, sp. n.

Colour ferrugineo- or ochraceo-olivaceous; head-plate ferrugineous.

Body moderately robust, nearly parallel-sided, more attenuated posteriorly than anteriorly.

Head not sulcate, about as wide as long, with convex sides and nearly straight posterior border, strongly punctured, its lateral margin distinctly raised.

Antennæ composed of 17 segments, whereof the basal two are hirsute, the rest densely pubescent.

Maxillipedes strongly punctured, the coxæ with anterior margin very nearly straight, thickened, the femur armed internally with a single tubercle.

Tergites strongly punctured, the first marked anteriorly with a strong, arched, transverse groove, from the sixth with raised margins, all of them entirely without trace of longitudinal sulci.

Sternites strongly punctured, without sulci.

Anal somite.—*Tergite* not sulcate, with parallel sides, the margin distinctly raised and posteriorly spined, the middle of the posterior border convexly produced posteriorly; *pleuræ* furnished with many close-set larger and smaller circular pores, the pores not attaining the superior margin, and leaving a large subquadrate smooth space around the superior posterior angle, the posterior border nearly vertical, the process smooth, small, slender, and terminated by a single spine; *sternite* much narrowed posteriorly, its posterior border convex; *legs* moderately long and moderately stout, the femur armed with two spiniform teeth, one in the middle of the upper inner edge, the other large, in the anterior half of the middle of the under surface; tarsi not pubescent, unarmed; claw spurred.

Legs.—Twenty-second pair with tarso-metatarsus unarmed and divided into a longer proximal and a shorter distal por-

tion; tarso-metatarsus of the rest undivided and armed with a single spine; tibia of the twenty-second pair armed with a single inferior spine, tibiæ of the rest armed in addition with a single anterior distal spine.

Length up to 41 millim.

Three specimens from S.E. Corea.

This species is closely related to *Ot. rubiginosus* of L. Koch, but differs in the entire absence of tergal sulci.

Scolopocryptops longiceps, sp. n.

Body robust, attenuated posteriorly.

Colour ochraceous, anteriorly darker; head, first tergite, and maxillipedes castaneous.

Head considerably longer than wide, with posterior angles widely rounded, nearly parallel-sided, coarsely punctured, without trace of sulci.

Antennæ moderately long, distally pubescent, proximally sparsely hirsute.

Maxillipedes coarsely punctured; coxæ with anterior border not at all produced, without teeth, widely and shallowly excavated in the middle, the margin of the excavation black and thickened, a transverse stria crossing the plate a little distance behind the anterior border; femoral tooth large, conical, pointed, and undivided.

Tergites.—The first marked before its anterior border by a strong arched sulcus, coarsely and sparsely punctured; from the third to the twenty-first coarsely but sparsely punctured and conspicuously bisulcate, from the seventh to the twenty-first with raised margins, the twenty-second without sulci and with the margins raised only anteriorly.

Sternites marked with conspicuous but scattered punctures, without sulci.

Anal somite.—*Tergite* with sides posteriorly converging, without sulci and with unraised margins, its posterior border convexly produced in the middle, the edge of the produced portion sinuate; *pleuræ* furnished with very many close-set larger and smaller pores, the pores above not quite attaining the suture which separates the tergite and pleuræ; a smooth quadrate area round the superior posterior angle, the posterior border directed obliquely backwards and downwards, the process tapering to a single point; *sternite* a little narrowed posteriorly, its posterior angles widely rounded, its posterior border shallowly and angularly excised in the middle; *legs* long, the segments a little dilated distally, sparsely hirsute proximally, slightly pubescent distally, the femur

furnished above in its anterior half on the upper inner edge with a large spiniform tooth, the middle of the under surface armed with an enormous spiniform tooth, which is larger than the spiniform process of the pleura; tarsus unarmed, claw not spurred.

Legs: twenty-second pair much longer and stronger than the twenty-first, with tarso-metatarsus divided into a longer proximal and a shorter distal segment, unarmed; twenty-first pair with tibia unarmed, tarso-metatarsus entire and armed with a distal spine; in the rest of the legs the tarso-metatarsus is entire, armed with a single spur, and the tibia armed with a single spur, the first and second pair having in addition an anterior tibial spur.

Length 60 millim., of anal leg 18·5, width of first tergite 6 millim., of twelfth 5, of twenty-third 2·7, of head 4·3; length of head 5.

A single specimen from Brazil.

Distinguished from *Sc. Miersii* and *mexicans* by the form of anterior border of the maxillary coxæ &c.

Newportia Ernsti, sp. n.

Colour testaceous or pale ochraceous; head and maxillipedes castaneous.

Body slender and nearly parallel-sided, attenuated quite at the posterior end.

Head a little longer than wide, its posterior border and posterior angles convex, sparsely and shortly hairy and marked with larger and smaller punctures, its posterior two thirds furnished with two fine, subparallel, anteriorly abbreviated sulci; a fine transverse sulcus in front of the posterior border.

Antennæ composed of 17 segments, the basal two or three hirsute, the rest pubescent.

Maxillipedes sparsely punctured and hairy; coxæ with anterior border but little produced, bilobate, being somewhat deeply but narrowly excavated in the middle line, and bearing on each side a wide, very short, obliquely set plate-like tooth; femur armed with a small tubercle internally.

Tergites.—The first marked anteriorly with a semicircular sulcus and throughout its length with two longitudinal sulci, which slightly converge in front of the transverse sulcus; the second, third, fourth, and twenty-second bisulcate, from the fifth to the twenty-first quadrisulcate, as in *Cryptops*; all punctured, and, except the last, with simple borders.

Sternites wider in front than behind, except the first, twenty-

second, and twenty-third, marked with three longitudinal sulci, one median posteriorly abbreviated, and on each side one lateral, running from the sides of the anterior border to a point on a level with the joint of the leg; the posterior six also furnished with a fine transverse sulcus, running from side to side immediately behind the terminations of the three longitudinal sulci; that part of each tergite which is concealed by the one immediately following it is defined by a deep, transverse, arched groove, the twenty-first marked in its anterior half by a fine transverse sulcus; the posterior sternites thickly punctured and hairy.

Anal somite.—Tergite with raised lateral margins and convexly produced posterior border, not sulcate; *pleuræ*, except the superior portion and the process, furnished with many conspicuous, close-set, circular pores, the process smooth, long, slender, and tipped with a simple spine; posterior border hairy, inner edge of the posterior border chitinous and serrate; *sternite* densely porous and hairy, wider in front than behind, its posterior border straight; *legs* long, the femur, patella, and tibia subequal in length, femur thickly hairy without and within, triangular in section, its upper surface posteriorly notched and grooved, its upper inner edge furnished with a row of spinules, its lower surface armed mesially with six large spines, the three anterior of which are smaller and close-set and the three posterior widely separated; patella somewhat sparsely hairy except below in front, armed beneath with two widely separated spines; tibia sparsely hairy, unarmed; tarso-metatarsus longer than the femur, patella, and tibia taken together, the proximal segment about one third the length of the tibia, the antenniform portion indistinctly articulated to and considerably narrower than the proximal portion, hirsute, the segments exceedingly numerous, very minute, and indistinctly defined, divided into two portions by a joint situated in its anterior half.

Legs.—The twenty-second pair much larger than the twenty-first, not spined, the tarso-metatarsus distinctly divided, the proximal segment being considerably longer than the distal, the patella, tibia, and tarsus densely hirsute; twenty-first pair of legs also unarmed, tarso-metatarsus undivided and, like the tibia, hirsute; all the rest of the legs with undivided sparsely hirsute tarso-metatarsus, an inferior distal tarsal spur, and an inferior and an anterior distal tibial spur; in the first pair the anterior tibial spur is missing; all the claws bicalcarate.

Length 34 millim., of anal leg 14.

One specimen from Caraccas, presented by Dr. Ernst; a second ticketed Brazil.

Resembling *N. mexicana*, Sauss., in its indistinctly multiarticulated tarso-metatarsus, but differing at least in the spine-armature of the anal legs. Thus in *N. mexicana* there is a row of three spines on the lower surface of the tibia and the upper inner edge of the femur is armed with spines which appear to be but little smaller than those along the under surface of this segment. In *N. Ernsti*, however, the tibia of the anal leg is unarmed and the armature of the upper inner edge of the femur consists of spinules which are very much smaller than the spines on the lower surface. The figure and description of *N. mexicana* furnish no information with respect to the sulci of the head, tergites, or sternites.

In the specimen from Brazil the anal legs are shorter than in the one from Caraccas, and the tarso-metatarsus is a little shorter than the femur, patella, and tibia.

Newportia brevipes, sp. n.

Colour testaceous or pale ochraceous; head and maxillipedes castaneous.

Body moderately robust, attenuated posteriorly.

Head with posterior and postero-lateral borders strongly convex, sparsely hairy, and sparsely punctured, marked in its posterior half by two fine anteriorly converging sulci.

Antennæ thick at the base, the three basal segments hirsute, the rest pubescent.

Maxillipedes sparsely punctured and hairy; anterior border of the coxæ not produced, nearly straight, lightly excised in the middle, with a wide, very short, dentiform plate on each side; femur unarmed.

Tergites.—The first marked in its anterior half with a transverse semicircular sulcus, the area defined by the sulcus being a segment of a circle, this portion only very indistinctly marked with longitudinal sulci, the portion posterior to the transverse sulcus furnished with two fine subparallel sulci; the second and twenty-second bisulcate, the third to the twenty-first quadrisulcate, as in *Cryptops*; the median area between the two complete sulci longitudinally depressed on each side of the middle line; margins unraised.

Sternites trisulcate, the median sulcus anteriorly and posteriorly abbreviated, the lateral sulci extending from the sides of the anterior border to a point on a level with or slightly beyond the joint of the legs; a few of the sternites towards the posterior end of the body marked in their posterior half

by a fine transverse sulcus which runs just behind the posterior terminations of the longitudinal sulci; the covered portion of the sternites defined by a strong, arched, forwardly convex, transverse groove.

Anal somite.—*Tergite* not sulcate, with raised margins, its posterior border slightly and convexly produced in the middle; *pleuræ* thickly covered anteriorly and inferiorly with circular close-set pores, posteriorly and superiorly smooth, the process smooth, slender, and simple, the internal edge of the posterior surface chitinous and subserrate; *sternite* wide, closely embracing the pleuræ, narrowed posteriorly, posterior surface concave; *legs* somewhat short, hairy, hairs on tarso-metatarsus longer and more scattered than on the other segments; the femur, patella, and tibia subequal in length, the patella being, however, slightly the longest; femur triangular in section, armed beneath with a series of five spines, its upper inner border furnished with a few minute spinules, its upper surface posteriorly notched; patella furnished below in its anterior half with a single small spine; tibia unspined; tarso-metatarsus not so long as the femur and patella taken together, evenly thick throughout and indistinctly multiarticulated throughout, the proximal segment neither thicker nor longer than the others.

Legs.—Twenty-second pair absent, twenty-first pair inferiorly hirsute, unarmed, twentieth pair also hairy; tibia armed distally with an anterior and an inferior spine, and the tarso-metatarsus with an inferior setiform spine; claws basally spurred, tarso-metatarsus indistinctly divided.

Length up to 22·5 millim., of anal leg 6·5.

Two specimens from George Town, Demerara, sent to the British Museum by Mr. J. J. Quelch.

Allied to *N. mexicana* and *N. Ernsti* in having the segments of the anal tarso-metatarsus indistinctly defined and very numerous.

From both it differs in that the proximal segment of the anal tarso-metatarsus is of the same size as, and in all respects similar to, the rest of the series. From *mexicana* it further differs in having the tibia of the anal leg unarmed and the upper inner edge of the femur at most furnished with a few minute spinules; and from *N. Ernsti* it may be recognized by the form of the sulci on the first tergite and head, the area defined by this tergal sulcus being in *N. Ernsti* ovately convex and marked by two distinct longitudinal sulci, whereas in *N. brevipes* it is very indistinctly divided and circularly convex; in this last species again there is no posterior transverse sulcus on the head-plate.

XIX.—*Note on* Diazona *and* Syntethys. By W. A. Herdman, D.Sc., Professor of Natural History in University College, Liverpool.

Mr. W. Garstang has lately drawn attention, in his "Report on the Tunicata of Plymouth" *, to the interesting point that the *Syntethys hebridicus* of Forbes and Goodsir has been considered by recent authors, on insufficient evidence, to be the same as *Diazona violacea*, Savigny, and that therefore it is possible that these two forms may be, if not distinct genera, at least distinct species.

The history of the matter is briefly as follows:—

Savigny, in 1816, described and figured † *Diazona violacea* from Mediterranean specimens found at the Balearic Isles, and established the genus *Diazona*, which he placed, in his 'Système des Ascidies,' at the head of the Téthyes composées immediately after the genus *Clavelina*. Amongst other points he describes and figures the colour as violet, the branchial and atrial apertures as being both distinctly six-rayed, the internal longitudinal bars of the branchial sac as bearing papillæ, and the meshes as containing each four stigmata.

Savigny was quoted and copied by various authors; but nothing of importance for the present purpose was added until 1851, when Forbes and Goodsir, in their paper "On some remarkable Marine Invertebrata new to the British Seas" ‡, described under the name of *Syntethys hebridicus* some specimens dredged in 30 fathoms close to Croulin Island, near Applecross, on the west coast of Scotland. They recognized the affinity of their new genus to Savigny's *Diazona*, and placed it between that genus and *Clavelina*. They point out that their species is of an apple-green hue, that the branchial and atrial apertures are not lobed (although the atrial has six white ocelli), that the ascidiozooids are marked by lines of white pigment, that the branchial sac has thirteen rows of stigmata, hooked fleshy tubercles at the angles of the meshes, and only one of the stigmata in each mesh. Forbes and Goodsir state as the characters distinguishing *Syntethys* from *Diazona* (1) the simple apertures and (2) the sessile abdomen; but, as Garstang has pointed out, the above details of structure of the branchial sac do not agree with those given by Savigny for *Diazona*.

* Journ. Mar. Biol. Assoc., n. s., vol. ii. no. 1, p. 47 (May 1891).

† Mém. pp. 35, 61, 116, pl. ii. fig. 3, and pl. xii.; Syst. p. 174.

‡ Trans. Roy. Soc. Edinb. vol. xx. pt. ii. p. 307.

Alder* in 1863 placed Forbes and Goodsir's species in the genus *Diazona* under the name of *D. hebridica*, and showed that it did not differ from Savigny's form in colour, since its living apple-green tint changed to violet on preservation in alcohol. He also noted that the apertures of his specimen from the Channel Islands were obscurely six-lobed, and thus brought the descriptions of the two forms so closely into accord that most subsequent writers have considered them to be the same species of *Diazona*, and the name *hebridica* has dropped out of use. *Diazona violacea* has since been found by Della Valle † and others in the Mediterranean, by Giard ‡ off the south-west coast of Brittany, by Lahille § off the north coast of Britanny and the Mediterranean coast of France, and by Garstang near Plymouth.

Lahille has recently (*loc. cit.* 1890) given a detailed description, and has shown that there may be as many as one hundred rows of stigmata in the branchial sac, that there are twenty-four tentacles, and that no true papillæ are placed at the angles of the meshes. His figures 136 and 137 show some meshes containing one, two, and three stigmata each. Finally, Garstang (1891), although admitting the generic identity of *Diazona* and *Syntethys*, tries to show that Alder's specimens from Guernsey were probably not identical with Forbes and Goodsir's species, and that the latter may be distinct from *D. violacea*. He points out the difference in the branchial sac between his own specimens from Plymouth, which he identifies as *D. violacea*, and the figures and description given by Forbes and Goodsir—the latter showing only thirteen rows of stigmata and only one of the stigmata in each mesh. Upon these and the other characters given by Forbes and Goodsir he redefines the species *Diazona hebridica*, but concludes by saying that "the whole matter is so beset with doubts that it is greatly to be desired that specimens should be obtained again from the Hebrides, and their anatomy redescribed" (*loc. cit.* p. 66). On reading this last sentence I at once remembered that I had in my collection a Hebridean specimen of *Diazona* dredged off the north coast of Mull in 1885 by the Duke of Argyll, and sent to me for identification through Dr. John Murray. I had examined the specimen in 1885, identified it as *D. violacea*, made some microscopic

* Ann. & Mag. Nat. Hist. (3) vol. xi. p. 169.

† 'Contrib. alla Storia naturale delle Ascidie composte del Golfo di Napoli,' 1877, p. 10; 'Nuove Contribuzioni,' 1881; and 'Sul Ringiovanimento &c.,' 1884.

‡ 'Comptes Rendus,' ciii. p. 755 (1886).

§ 'Recherches sur les Tuniciers,' &c., 1890, p. 257.

specimens of the ascidiozooids, a few drawings and some notes, and then laid it aside with the intention of returning to it again.

I have now, since reading Mr. Garstang's interesting remarks, re-examined the specimens of *Diazona* in my collection, which are:—

(1) A colony labelled *D. violacea*, from the Zoological Station, Naples;

(2) Part of a colony from near Plymouth, kindly sent to me by Mr. Garstang; and

(3) The Hebridean colony, dredged by the Duke of Argyll to the north of Mull;

with the result that I believe them all to be the same species, *D. violacea.*

To take up the supposed points of difference: in the first place, I find that many of the ascidiozooids in these preserved specimens have the branchial and atrial apertures so obscurely lobed that from the outside lobes cannot really be said to be present; and this is as much the case in the Naples and Plymouth specimens as in the Hebridean one. But when the test is removed and the siphons of the mantle are examined under the microscope it is found that in all three specimens each aperture is most distinctly six-lobed. In the condition of the apertures, then, my Hebridean colony is exactly like the southern forms, and in colour also the specimens (in spirit) are alike.

Then in regard to the number of transverse vessels or rows of stigmata in the branchial sac, I find in an ascidiozooid from the Naples colony over sixty rows, in one from the Hebridean specimen I have counted sixty-seven rows, and may have missed a few, and in the Plymouth specimen there are about eighty rows. It is difficult to get the exact number, as the rows are crowded in places; but the above numbers are under rather than over the mark, and they show clearly that the three colonies are practically alike in the extent of the branchial sac.

The next point is the number of stigmata in each mesh; and here I find very great variations in different parts of the branchial sac * in all three colonies. In the specimen from Plymouth I find most distinctly in some parts of the sac only one stigma in each mesh. There is also a single stigma behind each internal longitudinal bar, so that there are nearly

* Lahille (*loc. cit.* p. 257) figures, from Mediterranean specimens, meshes containing one, two, and three stigmata each.

twice as many stigmata present as are visible on the inner surface. The stigmata behind the bars seem to me smaller in size; but this I am not certain about. In other parts of this same sac I find meshes with two, three, or four stigmata. In the Naples specimen close to the dorsal edge, where the internal longitudinal bars are usually imperfect for as much as eight or nine series of meshes, I find the papilliform connecting-ducts, which indicate the position of undeveloped bars, placed one stigma apart, so that if meshes were formed there they would contain each one stigma only. In the Hebridean specimen there seem generally two or three stigmata in a mesh, sometimes four or five, some parts of the sac being in this respect exactly like Garstang's figure (*loc. cit.* pl. ii. fig. 7). I have not noticed meshes containing one stigma each so distinctly as in the Plymouth specimen, but I have no doubt such might be found by examining a few other ascidiozooids.

Finally, the "hooked fleshy tubercles" of Forbes and Goodsir's description can, as has been suggested before, be quite satisfactorily accounted for by the corrugation of the internal longitudinal bars, the thick prominent connecting-ducts which seem to project on each side where they join the bars, and the imperfect condition of the bars in some parts of the sac.

When a branchial sac is first opened and is examined in water under the microscope the appearance of large papillæ at the angles of the meshes is so distinct that it is difficult to realize, until the specimen has been stained, mounted, and examined with a high power, that only connecting-ducts and more or less irregular bars are present. There is no difficulty in understanding how some of the earlier investigators fell into the error of supposing that they saw large papillæ.

I think, then, that all the supposed peculiarities of *Syntethys hebridica* can be satisfactorily disposed of. Perhaps the only point in Forbes and Goodsir's description which still requires explanation is the thirteen rows of stigmata, and I can only suggest that, if there was no mistake about the observation, they may possibly have examined a young ascidiozooid with rather a small branchial sac. Unless the branchial sac is a fairly large one and is well spread out, it is only too easy to miss a great many of the rows of stigmata.

It is still, of course, open to any one to say that the Hebridean specimen dredged by the Duke of Argyll is, as I have shown above, *Diazona violacea*, but is not necessarily Forbes and Goodsir's *Syntethys hebridicus*. This is conceivable, but is not at all likely, since the specimens are prac-

tically from the same locality, and since, as I have pointed out, the peculiarities in the description of *Syntethys* can be easily accounted for on the supposition that Forbes and Goodsir's specimens were, like the Duke of Argyll's, the *Diazona violacea* of Savigny.

XX.—*Contributions towards a General History of the Marine Polyzoa*, 1880–91.—*Appendix*. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from p. 93.]

'Annals,' November 1880 (p. 28 sep.)

Steganoporella Rozieri, Audouin.

I have taken this species as the type of a new genus, *Thalamoporella*, distinguished from *Steganoporella* by important differences in the internal structure of the zoœcium *.

Ibid. (p. 29 sep.).

Steganoporella elongata, sp. n.

This species must be referred to the genus *Micropora*. The structure of the Steganoporellidæ had not been thoroughly investigated when my description of it was published; later researches have shown that it is not a member of this family, but finds its proper place in the kindred tribe of the Microporidæ.

Ibid. (p. 30 sep.).

Steganoporella Jervoisii, sp. n.

This form belongs to the genus *Thalamoporella*. The list of the recent species of *Steganoporella* which I have given (p. 30) is from the cause just mentioned defective. The first of the species which it contains, *Eschara impressa*, Moll, must be removed from it. Of the rest, *Flustra Rozieri*, Audouin, *Membranipora gothica*, Busk (= *S. Rozieri*, form *gothica*, mihi), and *Steganoporella Smittii*, Hincks, belong to the genus *Thalamoporella*; *Membranipora magnilabris*, Busk, is the only representative of the genus *Steganoporella* as now defined.

* "Critical Notes on the Polyzoa," 'Annals' for Feb. 1887, pp. 163, 164.

The synonymy of *Micropora impressa* contained in Miss Jelly's invaluable 'Catalogue' includes *Membranipora Andegavensis*, of Busk, and in a note at the close of it the author adds the following:—"Regarding the synonymy of this species it must be remarked that opinions differ. Hincks places the *Membranipora Andegavensis* of Busk as a synonym of *Steganoporella* (*Thalamoporella*) *Smittii* (B. M. P. 178)." My reason for doing so I have already explained (B. M. P. vol. i. pp. 178, 179). Through Mr. Busk's kindness I had the opportunity of examining the type-specimen of the *Membranipora Andegavensis* of the 'Crag Polyzoa.' So far as my recollection goes, I had been struck by the close resemblance between the avicularia of the latter and those of *Steganoporella Smittii*, which I was about to describe, and asked Mr. Busk to allow me to see his specimen. And, in passing, I may remark that the presence of the large and remarkable avicularia, which are clearly shown in Busk's figure of *M. Andegavensis*, is in itself conclusive as to the synonymic question. *Micropora impressa*, so far as I know, is altogether destitute of these appendages. On examining the type-specimen I found such a general agreement between it and the recent species as to leave no doubt respecting the identity of the two forms. The shape and structure of the avicularium are the same in both; this I was able to determine even with respect to the minute details, as in one or two cases the mandible of the avicularium had been preserved in the fossil specimen. What Mr. Busk's reasons might be for identifying his species with the *Eschara Andegavensis* of Michelin I have no means of knowing; but his own figure shows that he was mistaken. Michelin's species, there can be little doubt, is the *Eschara impressa* of Moll. *Membranipora Andegavensis* of Busk must therefore be removed from the synonymy of the latter.

Manzoni identifies *Membranipora calpensis*, Busk (which is no doubt *Eschara impressa* of Moll), with Michelin's *E. Andegavensis*, but follows Busk in referring the Crag species to the latter. Probably he merely copied Busk without careful examination of his figure.

Ibid. (p. 30 sep.).

Microporella fissa, sp. n.

On the whole I am inclined to refer this form to *Adeona violacea*, Johnston (sp.). The points of difference are the shape of the pore, the oblique direction of the suboral avicularium, the presence of zoœcia bearing a large lateral avicu-

larium of peculiar form and structure, instead of the small central one below the orifice, and the frequent occurrence of a second avicularium similar to the last-named on the lower part of the front wall. The pore, we now know, is liable (as in *Microporella decorata*) to very considerable variation within the limits of a species. The oblique direction of the suboral avicularium, on which Busk founded his *Lepralia plagiopora*, is, as I long since pointed out, a character of very small moment. The occurrence of the second small avicularium would hardly merit notice were it not the case that in *A. violacea*, as commonly met with, there is a remarkable constancy both as to number and character in this appendage. Amongst the large number of British specimens examined I have never met with any diversity of shape, a fact which gives more significance to the presence of the gigantic avicularium, with its elongate beak and scimitar-shaped mandible, than it would otherwise possess. It may be regarded as probably a local adaptive modification of the ordinary suboral form, which is always absent from the cells bearing the large lateral avicularium.

So far the latter has only been noticed on specimens from the Indian Ocean. When present it produces a remarkable change in the appearance of the zoœcium, which is much widened above, the increase being entirely on the avicularian side and being due to the presence of the large avicularian cell. The long curved beak is also carried up for some distance, causing an extension of the zoœcium above. The transformation of the avicularium in some of the cells of a colony (as in *Smittia nitida*, Verrill, p. 46 sep.) is of not uncommon occurrence; but I cannot recollect a case in which it so materially affects the aspect of the zoœcium.

A question arises as to the true specific name of the *A. violacea*, Johnston (sp.). In her 'Synonymic Catalogue' Miss Jelly records it as *Microporella Heckeli*, Reuss, on the ground that Reuss described it in 1847 and Johnston in his second edition, bearing date 1849. This is an error, and I regret to say that I am responsible for it. In the Bibliography at the close of my Hist. Brit. Mar. Polyzoa, through an oversight in correcting the proof, 1849 is given as the date of Johnston's second edition, which was really published in 1847, the same year as that in which Reuss's Pol. d. Wiener Tertiärbeck. appeared. Johnston's preface is dated April 1847, and unless it can be shown that the German author's book was published earlier in the year, there is no ground whatever for the change.

It is not probable that Johnston's claim will be disputed.

Ibid. (p. 31 sep.).

Porella rostrata, sp. n.

In Miss Jelly's 'Catalogue' *Lepralia papillifera*, MacGillivray, is given as a synonym of the above. Neither the description nor the figure in the 'Prodromus of the Zoology of Victoria' would lead me to identify the two; but if there is any sufficient ground for regarding them as one and the same species MacGillivray's name should supplant mine, as it was first published in 1868.

Ibid. (p. 32 sep.).

Mucronella tubulosa, sp. n.

Waters * ranks this species as a synonym of *Rhynchopora longirostris*, Hincks; but the species are entirely distinct. The most significant characters of *Rhynchopora* are wanting in *M. tubulosa*.

'Annals,' Feb. 1881 (p. 34 sep.).

Membranipora bicolor, sp. n.

In the description of this species it should be added that there is commonly a rather prominent nodule on the elongate interspace which separates the zoœcia in the same line from each other.

Ibid. (p. 37 sep.).

Membranipora patula, sp. n.

Additional Locality. Queen Charlotte Islands, very common.

Ibid. (p. 37 sep.).

Membranipora spinosa, Quoy and Gaimard.

Jullien has formed a new genus for this species (*Chaperia*), with the following diagnosis:—"Deux lames calcaires internes, à extrémités fixes et servant à l'insertion des fibres musculaires rétractrices de l'opercule" †. This genus is made the type of a family group Chaperidæ.

It is hardly possible without an extended comparative study of the opercular mechanism to estimate the precise

* 'Annals,' ser. 6, vol. iv. p. 19, "On Australian Bryozoa."

† 'Mission du Cap-Horn, Bryozoaires,' p. 61, pl. v. figs. 3–5, and pl. xv. figs. 4, 5.

systematic value of this character. But I confess it seems to me unlikely that it has the kind of importance which Dr. Jullien assigns to it.

Additional Locality. Cape of Good Hope, common (*M. Maurice Chaper*).

Ibid. (p. 38 sep.).

Membranipora permunita, sp. n.

This species is ranked as a variety of *Cellepora Michaudiana*, d'Orb., by Waters *. Miss Jelly, in her 'Catalogue,' reverses this decision on the ground of the important difference in the avicularia, and places the latter amongst the synonyms of the present form. The distinction, however, between the avicularia, though sufficiently striking (they belong to different classes), is by no means the only ground for separating the two forms. The zoœcia are also described, not merely in slight particulars, but in general character. It is sufficient to instance the marked difference between the apertures of the two species both in form and in the proportion which they bear to the rest of the area. *M. permunita* is clearly not a mere variety of *M. Michaudiana*, but a distinct species; and the latter has therefore no claim to a place in the synonymy.

Ibid. (p. 39 sep.).

Membranipora (*Caleschara*) *denticulata*, MacGillivray.

The account which I have given of the structure of the cell in this species is, I believe, strictly correct; but I certainly do not adhere to my interpretation of it. *Caleschara* belongs to the family Steganoporellidæ † (which had not been properly defined when my paper was written), and would find a place in the genus *Onychocella*, Jullien, but for the entire

* "On Cheilostomatous Bryozoa from Aldinga &c., South Australia," Quart. Journ. Geol. Soc., August 1885, p. 289.

† In the definition which I have given of this family ("Critical Notes," 'Annals,' Feb. 1887, p. 162) the membranous front wall is described as "carrying the orifice and operculum." But this is not universally true of the forms embraced in it. It is the case in *Onychocella*, Jullien, and kindred forms, but not in *Steganoporella* and *Thalamoporella*. This character must therefore be removed from the family diagnosis. Probably this difference is sufficiently important to warrant a division of the family. Jullien's group Onychocellidæ has been formed for species in which the membranous ectocyst carries the orifice. In these forms the true front wall is in all respects similar to that of the *Membraniporæ*, and the orifice and operculum are of the primitive Membraniporidan type.

absence of avicularia. As, however, it agrees in the more essential elements of structure with this tribe, the absence of the appendages should hardly separate it from its kindred. In his diagnosis of the family (Onychocellidæ) Jullien describes the avicularia as "plus ou moins constants."

MacGillivray's genus *Caleschara* is hardly tenable, as from the condition of his specimens he has been unable to give in his diagnosis a sufficient indication of the distinctive characters. The "*generic character*" is not such as to enable the student to appreciate the peculiarities of the type. Apart from what relates to the habit of growth and other non-essential points, there is nothing but the following clause:—"Front calcareous, except a small part anteriorly, which is membranous."

According to ordinary usage a genus so constituted must give place to one founded on a diagnosis sufficient for identification. Jullien's *Onychocella* with a very slight revision and somewhat wider scope would include *Membranipora antiqua*, Busk, and kindred forms, as well as *Caleschara*. Busk (in his 'Challenger' Report) adopts MacGillivray's name, and associates it with a new generic character. The whole subject requires fresh treatment.

Ibid. (p. 41 sep.).

Note on Membranipora transversa, *Hincks* (=M. cincta, *Hutton*).

This form seems to be nearly allied to *Onychocella* and *Caleschara*. The membranous ectocyst bears the orifice, and below it a calcareous wall passes down from the elliptical opesia to the base of the cell, dividing it into two chambers*.

Ibid. (p. 43 sep.).

Vincularia abyssicola, Smitt.

The old genus *Vincularia* was founded on the erect sub-cylindrical habit of growth, and is now superseded †. The present species is the type of the genus *Smittipora*, Jullien, but in my judgment should be transferred (as I have already stated) to *Onychocella*, Jullien, *revised*.

* On page 42 (sep.), line 15 from the top, *for* strong *read* stony.

† Busk indeed has retained the name in the 'Challenger' Report, but has connected with it a new definition. He assigns it to a genus "intermediate between *Micropora* and *Steganoporella*," *and with a cylindrical or polygonal habit of growth*. Such a genus is quite inconsistent with the later views of classification.

The portion of this paragraph from p. 42, line 8 from the bottom, " I mention this " &c., to p. 43, line 4 from the top (inclusive), may be cancelled.

Ibid. (p. 44 sep.).

DIACHORIS, Busk.

The species of *Diachoris* must be ranged under the genus *Beania*, Johnston. There are no generic differences between the two forms. In both the zoœcial characters are Bicellarian; *Diachoris*, which is usually furnished with articulated avicularia, making a nearer approach than *Beania* to *Bugula*, from which indeed it is chiefly distinguished by the more complex character of its zoarium *. MacGillivray has already united the two genera under the earlier name *Beania*†.

'Annals,' July 1881 (p. 49 sep.).

Membranipora radicifera, sp. n.

This was the first species of *Membranipora* in which attachment by means of tubular fibres had been observed. Since its discovery the same structural peculiarity has occurred in several forms, and may prove to be far from uncommon. A more systematic study of the radical appendages is a desideratum, and would form a very interesting chapter in the history of the Polyzoa.

MacGillivray has placed this species in the genus *Beania*, a decision which I am quite unable to accept (see " Critical Notes," 'Annals,' ser. 5, vol. xix. p. 158).

Ibid. (p. 55 sep.).

Steganoporella magnilabris, Busk.

In the last line of this paragraph for "*Lepralia*" read *Membranipora*.

Ibid. (p. 55 sep.).

Cribrilina ferox, MacGillivray.

This species has certainly no right to a place in the genus *Cribrilina*, from which it is separated by the remarkable

* Brit. Mar. Polyzoa, vol. i. pp. 65, 66.
† Prodr. Zool. Victoria, dec. xii. p. 67.

structure of its cell-wall and other characters. MacGillivray has constituted the genus *Hiantopora* for its reception. It is one of the forms which is attached by tubular fibres.

[To be continued.]

XXI.—*On the Molluscan Genera* Cyclostoma *and* Pomatias *and the Crinoid Genus* Comaster *and Family* Comatulidæ. By the Rev. Canon A. M. Norman.

It is not my habit to write for controversy, but for science's sake, and I do not quite follow Mr. Newton when he says ('Annals,' June 1891, p. 522) that my statement that I thought he had "misapprehended the facts" betrays an "amount of prejudice." One thing is certain: either he has "misapprehended" the facts or I have done so. I merely gave the facts opposing his views in my last notes, hoping that this would suffice for my purpose, and not desiring to point out too closely what I considered to be errors of statement. It seems, however, now necessary to notice these. I will therefore examine his arguments in detail.

1. The opening words of his first paper ('Annals,' vol. vii. p. 345) were "Much confusion has existed since Lamarckian days regarding the Molluscan name of *Cyclostoma*." There was much confusion, I grant, *in* Lamarckian days; but it would be difficult to find any genus which has received more universal acceptance for ninety years than *Cyclostoma* (or *Cyclostomus*), with its type *C. elegans*. Confusion is only introduced when Mr. Newton proposes to substitute *Pomatias* for that time-honoured name.

2. Mr. Newton argues that Lamarck described *two different* genera which he named *Cyclostoma*.

My reply is, Lamarck (as I showed in the 'Annals' for May last) did not describe two different genera named *Cyclostoma*. His definition in 1799 was intended to cover every species which he or other authors subsequently placed in it; he gave *Turbo scalaris* as an example (*type*, as used in modern times, was not then understood). The subsequent limitations of the genus were as follows:—

1799. *Cyclostoma*, Lamarck. *Cyclostoma scalaris*.

1801 *. *Cyclostoma*, Lamarck (= Lamarck, 1799, partim). *Cyclostoma delphinus*.

* In definition of genus Lamarck here adds the words "sans côtes longitudinales," to restrict the genus and exclude *Turbo scalaris* (= *Scalaria*).

1801. *Scalaria*, Lamarck (= *Cyclostoma*, Lamarck, 1799, partim). *Scalaria scalaris* (= *Cyclostoma scalaris*, 1799).

1801. *Cyclostoma,* Draparnaud (= *Cyclostoma*, Lamarck, 1799, partim). For *Nerita elegans* and all operculated inland Mollusca (except *Valvata*).

1803. *Cyclostoma*, Lamarck. Used by Lamarck in Draparnaud's restricted sense, and similarly by all subsequent writers.

1803. *Delphinula*, Lamarck (= *Cyclostoma*, Lamarck, 1799, and 1801 partim). For *Turbo delphinus*, L., = *Cyclostoma delphinus*, Lamk.

Thus Lamarck in 1801 removed *Scalaria* out of his comprehensive genus, and in 1803 he acquiesced in Draparnaud's more restricted use of the name to inland Mollusca, in which the animal had "Tentacles oculés à la base externe, mufle proboscidiforme." In my previous notes (*ibid.* p. 447) I quoted Deshayes (in Lamarck), who explained the whole matter. I may also refer to Lamarck himself as accepting Draparnaud's restricted genus ('Annales du Muséum,' vol. iv. (1804) p. 108), also to Felix de Roissy in De Montfort's 'Hist. Nat. gén. et partic. des Mollusques,' vol. v. (1805) pp. 290, 295, and 300, and De Montfort, 'Conchyliologie systématique,' vol. ii. (1810) pp. 131, 287, and 295. These and subsequent authors to the present time have acquiesced in the restricted use of *Cyclostoma*, with *C. elegans* as type.

3. That Draparnaud, 1801, established another genus *Cyclostoma*. "No notice, however, is made by this author to the preoccupation of the generic name in 1799, and we can only infer that Draparnaud was ignorant of its existence."

Is it not a most extraordinary misapprehension that Draparnaud founded his *Cyclostoma* in ignorance of Lamarck's *Cyclostoma*? Why, Draparnaud was a brother Frenchman and Lamarck's conchological friend. It was in consequence of the recommendation of Lamarck, Cuvier, and Lacépède that Draparnaud's posthumous work on the Mollusca was published. Authors' names were not written after genera in those days, and therefore Draparnaud wrote "*Cyclostoma*," not "*Cyclostoma*, Lamarck."

4. Mr. Newton states that Studer established a genus *Pomatias* in 1789, and placed two species under it—*P. elegans*, = *Nerita elegans*, Müll.," with reference, and "*P. variegatus*, a new species;" and that Hartmann in 1821, "apparently

ignorant of Studer's work of 1789, describes another *Pomatias*, and uses *Cyclostoma patulum* as the type."

Is not this another misapprehension? Did it not strike Mr. Newton as remarkable that Hartmann should have coined a name identical with that of Studer for the same genus, and is he aware that in the same year, 1821, Hartmann ('Neue Alp.' p. 214) actually named a species *P. Studeri*?

This statement in Mr. Newton's first paper is surpassed by the following sentence in his second paper:—"He [*i. e.* Norman] appears to be only anxious to demonstrate that we should follow the opinion most generally received by conchologists on this subject [*i. e.* in retaining *Cyclostoma*], instead of thinking it a matter for congratulation that the discovery of the Studerian genus now relieves us from the difficulties that have surrounded *Cyclostoma* for upwards of ninety years." This sentence appears to admit of no other interpretation than that, as Studer's genus *Pomatias* was according to Mr. Newton unknown to Hartmann, so, according to him, it has remained unknown to conchologists until 1891, when it was discovered by himself! I take down all the works from my library which I remember to contain *Pomatias* of Studer (as used for *P. variegatus* and allies) or of Hartmann, and give the following result of the ways in which this genus is quoted by those writers:—

"*Pomatias, Studer*" (*sic*): thus used in Adami, Cristofori and Jan, Charpentier, Stabile, Dupuy, Brusina, H. and A. Adams, S. P. Woodward, Kobelt, Clessin, Westerlund.

"*Pomatias, Hartmann*" (*sic*): Pini.

"*Pomatias, Hartmann non Studer*" (*sic*): Moquin-Tandon.

"*Pomatias* (*Studer* 1789), *Hartmann* 1821" (*sic*): Paul Fischer.

In this last reference Fischer puts the matter in a nutshell. The genus is the genus *Pomatias* of Studer, and he uses it in the restricted sense as employed by Hartmann. As I stated in my last notes, Hartmann, when *he* discovered *Pomatias*, Studer, acted very wisely in leaving the well-established *Cyclostoma* undisturbed and in applying *Pomatias* to the group for which he wished to find a name, and which included the second species mentioned by Studer. His action, moreover, was fully in accordance with the later Brit. Assoc. rules, and cannot lawfully be altered.

5. Mr. Newton maintains that *Cyclostoma*, Lamarck, must

be applied only to the genus which contains "*Turbo scalaris*;" nor will he be content to write *Cyclostoma*, Drap., because there was a previous *Cyclostoma*, Lamarck, though not in use. But he will not accept the only logical conclusion of his own argument, which, if granted to be true, would necessitate *Cyclostoma* superseding *Scalaria*. So he hunts for something earlier, and finds *Scala*, Klein; but then this is prebinomial, so will not do, and so he catches at a straw, and finds *Scala*, Humphrey, 'Museum Colonnianum,' 1797, two years antedating *Cyclostoma*, Lamarck, and which has been used by Mr. Dall. What is the history of this *Scala*, Humphrey? It seems scarcely to be believed that its authority rests upon the fact that a name, "anonymous and undescribed" (*Dall*), was inserted in a sale catalogue—nothing more than a pre-Linnean name applied to a shell for sale; and this is to be enough to give it post-Linnean authority! It may be expected after this that frequent reference will be made ninety years hence to "Stevens's" sale catalogues, for would there not be *Scala*, the precedent for their authoritative use*.

Lastly, Mr. Newton objects to the last part of Brit. Assoc. Rule 10, which allows the retention of a generic or specific name if no similar prior name is *in use*; and he refers to the American and French rules, which cannot claim to have been yet accepted generally even in the countries in which they originated, whereas the B. A. rules have the highest authority and the widest usage. That this Rule 10 is generally accepted on the continent has been proved by references in this very discussion, for I showed in my last notes that two of the leading zoologists of the continent, G. O. Sars and Schulze, observed it, and all the conchologists who write *Cyclostoma*, Drap.—and their name is legion—do the same. Mr. Newton asks whether I am aware that in my recent "Revision of British Mollusca," 1890, where I "place under review some seventy or eighty genera, about a dozen of them are preoccupied names †, and whether they remain so in my desire to carry out strictly to the letter my interpretation of the latter portion of Rule 10." I am always thankful to be put right when I am wrong; but I am not aware of any thing of the kind, and think that Mr. Newton is here again under a

* I cannot acquiesce in Mr. Dall's conclusions, but a very full statement of the case by him will be found in Bull. Soc. Comp. Zool. vol. xviii. (1889) p. 299.

† One name, *Cryptaxis*, I advisedly retained, though knowing it to be preoccupied and that it could not stand. I was unwilling to give a new generic name to a species which, when better known, will probably find a resting-place in an existing genus, and therefore for the present thought it best to leave it with Jeffreys's description and Jeffreys's name.

"misapprehension." But granted, for the sake of argument, that his suggestion is true, he must see that he has put the strongest possible argument into my hands for the retention of the rule as it stands. Here is a rule-of-three sum: If he would supersede the use of twelve out of eighty names of genera because the names, though not in use, had been employed at an earlier date, what slaughter would he make among the, say, fifty thousand generic names contained in "Scudder"?

The laws of priority were drawn up that justice might be done to the earlier author, but were never intended to be applied for the purpose of upsetting groups of genera which, having the sanction of ninety years' usage, have been employed, and can still be employed, without injustice to any one. "Possession is nine points of the law," and the undisputed retention of property for twenty years constitutes a right of possession *. I would call attention to the "common sense" contained in the suggestive note in this month's (July) 'Annals' by Prof. Jeffrey Bell, "A Test Case for the Law of Priority." The overstrained pressure of every law becomes its abuse—"Summum jus summa injuria."

Comaster and *Comatulidæ*.

I must add a few words in reply to Mr. F. A. Bather's observations ('Annals,' vol. vii. p. 464) on my notes on Crinoidea.

Mr. Bather calls attention to the fact that the name I proposed for a genus to contain the doubtful *Comatula multiradiata* of Goldfuss, "*Goldfussia*," is preoccupied. Though not in the 'Nomenclators,' I find this is the case; but neither *Goldfussia* of Castelnau or of myself are likely to stand. I only gave a name to take away the opportunity of any one saying that "*Comaster* is in use for something else," however wrongly so in use.

I shall reply to Mr. Bather so briefly that it will be necessary to refer to what has been in my and his notes written on the subject to understand my meaning.

Mr. Bather writes:—"(1) The priority of the name *Comaster* to *Actinometra* is no new discovery; but (2) the

* This day's 'Times' (July 10) contains a curious case of one Joseph Jacobs, whose cocks and hens cannot, by all the authority of the London County Council, be turned off the "now greatly improved and beautified' Plumpstead Common, because it was proved that these cocks and hens and their papas and mammas had taken their exercise there for the last fifty years.

diagnosis given by Agassiz was worthless; while (3) Canon Norman has not told us what we are to understand by *Comatula multiradiata*, Lamarck."

(1) Exactly, that was my argument. If it had been a new discovery no blame would have attached to those who, knowing *Comaster* to be earlier, use *Actinometra*.

(2) Worthless! It would be interesting to know what old genera are sufficiently described to satisfy Mr. Bather's requirements.

(3) There was no call for me to do so. Carpenter has taken great pains in the matter, and after examination of types considers that Lamarck included two species under *Comatula multiradiata*; both of these he places in *Actinometra*, and makes the earlier-described *Comaster*, Agassiz (of which this same *Comatula multiradiata* was the type *), a synonym of the later-described *Actinometra*—a course contrary to law and to justice.

Mr. Bather's next statement is:—

"When the time arrives for splitting up the assemblage of genera at present lumped together as Comatulidæ, the name Antedonidæ should certainly be applied to that family in which *Antedon* is placed. But while such different forms as *Thaumatocrinus*, *Atelecrinus*, and *Promachocrinus* swell the motley crowd, the name Comatulidæ seems, from its very want of meaning, the best adapted to embrace them."

What does Mr. Bather imply by "want of meaning"? I must go to school again. Comatulidæ, I had supposed, meant Comatulidæ, and was = Comatulidæ, *i. e.* the genus *Comatula* and its allies; and as *Comatula* is a synonym of *Antedon*, therefore Comatulidæ = Antedonidæ = *Antedon* and its allies. But Mr. Bather puts me right and tells me practically that I must not believe any thing I see in print, and that when Carpenter ('Challenger' Report) gives and fully describes (p. 6) the "Family Comatulidæ," he is doing nothing of the kind, even though the family is headed thus—"Family Comatulidæ, d'Orbigny, 1852; *emend.* P. H. Carpenter, 1888," and that I must not understand him as meaning what he says, when, after referring to the three older genera of the family, Carpenter writes:—"Three new genera have been established by myself for new types of recent *Comatulæ*, viz. *Atelecrinus*, *Promachocrinus*, and *Thaumatocrinus*; and these six are *all that could strictly be included* † in the family Comatulidæ until quite recently."

* In the 'Annals,' 1891, vol. vii. p. 387, last line but one from bottom, I see I have made an error:—*For* "Group 3. typica" *read* "Group 7. Fimbriata."

† The italics are mine.

XXII.—*Additions to the Invertebrate Fauna of St. Andrews Bay.* By ERNEST W. L. HOLT, Assistant Naturalist to the Royal Dublin Society's Fishery Survey, and late of the St. Andrews Marine Laboratory.

[Plate XI.]

PROFESSOR M'INTOSH, to whom I am indebted for the use of the Marine Laboratory during a stay of eighteen months at St. Andrews, has asked me to furnish a brief record of such forms, new to the local fauna, as came under my observation during that period. They were obtained for the most part by the use of the tow-nets or from the lines of the St. Andrews fishermen, whose kindness in allowing us to overhaul their gear and in bringing to the laboratory specimens which had excited their own curiosity cannot be too highly appreciated.

INFUSORIA.

On April 1, 1890, a specimen of *Caligus rapax* brought up in the bottom tow-net was noticed to be beset posteriorly by a number of foreign organisms which on close examination proved to be Acinetid Infusorians apparently belonging to the genus *Hemiophrya*. Figure 1 (Pl. XI.) represents the host and its epizoic parasites as they appeared on the following day. On the day of capture most of the Infusorians were covered in the apical region with gemmules, which had all been liberated when the drawing was made.

Hemiophrya is characterized by the possession of tentacles of two orders, of which the suctorial ones appear to be usually very minute. In the specimens before us no suctorial tentacles were discernible, and, judging from Saville Kent's figures ('Manual of Infusoria,' pl. xvii.), this is occasionally the case with other species of this genus.

Sir John Dalyell, in 'The Powers of the Creator displayed in the Creation' (vol. i. p. 249, pl. lxvi. fig. 10), mentions and figures "a minute zoophyte" from the dorsal region of a *Caligus*. I think that a glance at his figure leaves no doubt but that he was misled, as I was at first myself, by the resemblance of the form before us to a Hydroid. As our form does not agree exactly with any other species of which I have been able to find a description, I would propose to name it after its first observer.

Hemiophrya Dalyelli, sp. n. (Pl. XI. figs. 1–4.)

Pedicle or tube hyaline, finely granular, not striated,

slightly curved, about six times as long as body; at distal end about half the greatest width of body when fully extended (as in fig. 2), tapering gradually towards the base.

Body yellowish brown by transmitted light, subject to considerable variations of shape (see figs. 2, 3, and 4). Prehensile tentacles about as long as body, confined to apical region, and showing a spiral structure internally under a high power.

Length of tube in largest specimens about 1 millim.

Hab. On *Caligus rapax.*

POLYCHÆTA.

Polygordius, sp.

The larvæ of a species of *Polygordius* occurred in the surface-nets on August 19 and October 23 and 25, 1890. Several were observed to undergo their final metamorphosis after a few days' life in the laboratory. Its appearance in these waters is somewhat surprising.

NEMERTEA.

A *Pilidium* larva was taken at the surface on October 13, 1890. It measured ·71 millim. in greatest length, the height without flagellum being about the same. The flagellum consisted of a bunch of fine vibratile filaments, which usually adhered so closely together as to have the appearance of a single tapering appendage. The ventral margins in life showed a beautiful arrangement of reddish-brown pigment at the bases of the cilia. The prostomial disks were a pale yellow colour, and the stomach was filled with a brownish mass interspersed with black dots.

Pl. XI. figs. 5 and 6 represent the larva in lateral and anterior views.

Professor M'Intosh informs me that no Nemertean known to undergo a *Pilidium* stage has been recorded from the adjacent waters.

HYDROIDA.

Euphysa aurata (Forbes), the gonozooid of *Corymorpha nana* (Hincks), was taken at the surface in the beginning of August 1890. A species of *Corymorpha* is known to inhabit the bay, but recent attempts to dredge it have not proved successful. This gonozooid does not seem to have been met with here before.

Gonozooids belonging to a species of *Hybocodon* were obtained in considerable numbers in the bottom-nets in April and May 1890. Their occurrence suggests the presence of a second species of *Corymorpha* in the bay.

Siphonophora.

Two examples of a form allied to *Agalmopsis*, but apparently undescribed, were taken in the bottom-net in May 1890 in company with *Hybocodon*. I have handed over the specimens of both these forms, together with such notes and drawings as I made of them, to the Rev. A. D. Sloan, M.A., B.Sc., who is making a careful investigation of them *.

Gastropoda.

Pleurophyllidia Lœveni, Bergh.

Specimens of this rare British mollusk were obtained for the first time from the haddock-lines from the mouth of the bay in the autumn of 1889 and in April 1890.

Idalia aspersa (A. & H.).

On examining a large *Molgula arenosa* brought up by the haddock-lines from the sandy part of the bay a specimen of this rare mollusk was found to have effected a lodgment inside the test, which was somewhat torn.

Tritonia Hombergii (Cuv.).

A perfectly white specimen was brought in on the haddock-lines in the spring of 1890. The mollusk is not rare in the neighbourhood of the Bell Rock.

Enteropneusta.

A few *Tornaria* larvæ were taken at the surface on the 6th and 7th August, 1890. They appeared to be identical with those described by Bourne from Plymouth, which are the only others recorded from British waters. *Balanoglossus* is not known to occur anywhere in the neighbourhood of St. Andrews.

EXPLANATION OF PLATE XI.

Fig. 1. *Caligus rapax*, with epizoic *Hemiophrya Dalyelli*, sp. n.
Figs. 2–4. Animals and portions of the tubes of the last-named in various states of expansion; more highly magnified.
Figs. 6 & 7. Lateral and anterior views of *Pilidium* larva. *fl*, flagellum; *p.s.d.*, prostomial disk; *st.*, stomach.

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* *Vide* Ann. & Mag. Nat. Hist., May 1891.

BIBLIOGRAPHICAL NOTICE.

Contribuições á Paleontologia do Brazil. (With the original in English.) By Charles A. White, M.D., Palæontologist to the Geological Survey of the United States, &c.—*Archivos do Museu Nacional do Rio Janeiro*, vol. vii. 4to, National Press, Rio Janeiro, 1887. Pp. 1–273, with Index, pp. i–v, and 28 plates.

These contributions to the Palæontology of Brazil have resulted from a study of Cretaceous Invertebrate Fossils collected by the Brazilian Geological Survey under the direction of the late Prof. Ch. Fred. Hartt, and preserved by the care of Mr. Orville A. Derby, who accepted the position of Director of the Geological Section of the Brazilian National Museum, for the purpose of preserving these results of the Survey, which have now been confided to Dr. White, by the Director of the Brazilian National Museum at Rio de Janeiro, for publication.

After a warm recognition of the enlightened support and encouragement given to science, and to the Geological Survey in particular, by His Imperial Majesty Dom Pedro II., Dr. White proceeds to a careful bibliography of books and memoirs illustrative of South-American Mesozoic Invertebrata, from 1839 to 1881.

The fossils sent to Dr. White for description and illustration comprise Conchifera, Gasteropoda, Cephalopoda, one Polyzoon, and Echinodermata from the marine strata, and the Molluscan fauna of the freshwater Bahia group. These are described and figured in this order.

At pp. 7–14 Mr. O. A. Derby supplies, chiefly from his own personal observations, an account of the strata from which these fossils were obtained. The marine fossils here described were collected from beds in detached basins, lying on probably Palæozoic rocks, along the coast from the mouth of the Amazon to that of the Rio Reale, about lat. 12° S., namely the basins of Para, Pernambuco, and Sergipe. Further south similarly situated freshwater basins occur along the coast of the province of Bahia, to about lat. 18° S., namely those of Bahia and of Southern Bahia or the Abrolhos Islands.

Although some among the marine fossils have a Jurassic aspect, yet all are integral parts of a true Cretaceous fauna, differing much from any others, except (to some extent) that of Southern India and that of Gosau in the Tyrol. The homotaxial relationship of these fossils is carefully noted by Dr. White. Very many of the specimens are casts and not well preserved ; but the Author, desirous of making them useful to geologists, has sedulously worked out their zoological characters as far as possible, and has defined:—82 Conchifera (including 58 new species, besides 5 which may be generically, but not specifically determined) ; 91 Gasteropoda (including 77 new species and 7 not specifically named) ; 13 Cephalopoda (namely 11 Ammonites, 8 new species, with 1 *Helicoceras*,

sp. n., and 1 *Nautilus*); and 15 Echinodermata (of Cidaridæ 10 new species and a fragment; of Galeritidæ 2 new species; of Cassidulidæ 2 new species; of Spatangidæ 2 species, 1 of them new; and one fragment of an Asterid).

To the 6 species of Mollusks already known from the freshwater group 5 species are now added, and all but one of them are figured together on plate xxvi.

Prof. E. D. Cope has compared the Vertebrate fossils from the Pernambuco basin with those of the Fox-hill group of the Western United States, and those of the Bahia freshwater group with the fossils of the Laramie group of the same region, these two being the upper members of the Cretaceous series of North America.

Mr. Derby mentions at p. 8 that, from about the latitude of Bahia northward to the coast near the city of Maranham, the high interior plateau, against which the fossiliferous strata of the coast abut, is overlain by a thick series of sandstones and shales, which at several points have yielded many fish-remains, regarded as of Cretaceous age by Agassiz, but Jurassic by Newberry and Cope. Presumably older than the coast basins, and divided from them by an uprise of the land, should the plateau-beds prove to be of Cretaceous age, those on the coast will be referred to the middle or later part of that age.

The exact distribution of the marine fossils described by Dr. A. C. White is exhibited in an extensive and valuable table (with an explanation) by Mr. O. A. Derby at pages 264–271, "so as to facilitate the examination of the question as to whether the fauna of any of these localities (27 altogether) presents differences that indicate distinct geological horizons, or only such as might be expected from differences in geographical position, in the character of the rocks, and in the degree of completeness in which the fauna of each locality is represented in the collections."

The descriptions of the fossils (pp. 20–263) are enriched with Dr. White's wide experience of the varietal changes and migrational distribution of such organisms. The twenty-eight quarto lithographed plates give admirable representations of the specimens, whether perfect or otherwise, evidently with careful exactness; and with them and the elaborate descriptions we have a very valuable work of reference both for geologists interested in Brazil and for those who may be studying the Cretaceous formations in other parts of the world.

MISCELLANEOUS.

The Development of the Central Nervous System of the Pulmonata. By Dr. Ferd. Schmidt.

Although the development of the Gastropods, and of the Pulmonata in particular, has already often been the subject of close

investigation, the knowledge which we possess about it must still be termed incomplete. This is to a certain extent due to the fact that the majority of the treatises dealing with the question belong to a period at which the methods of investigation were not sufficiently developed, and when, moreover, many questions, the solution of which is to-day a matter of the first importance, were as yet entirely untouched. Recent writers have satisfactorily filled up a portion of these gaps in the development of the Gastropods, yet many a question—and this applies especially to the Pulmonata—still awaits its solution. I had the opportunity of collecting and examining a rich material of embryos of different terrestrial Pulmonates, and I purpose to give in the following pages a brief account of certain results of my investigations, which are not yet completely concluded, concerning the *development of the central nervous system.* An exhaustive account of the development of this, as well as of the remaining systems of organs, will, however, be reserved for a subsequent publication, in which my statements, supported by figures, shall be compared with those already to be found in the literature of the subject.

I investigated the development of the following forms:—*Succinea putris*, L., *Clausilia laminata*, Mont., and a few other species of the same genus; *Limax cinereo-niger* and *L. agrestis*, L. Excluding a few deviations, the forms mentioned agree well together in their development. The statements in the present paper refer to *Limax agrestis* and *Clausilia laminata.*

The entire central nervous system arises by proliferation of the external epithelium of the body, and is therefore exclusively ectodermal in origin, a fact which agrees with all reliable statements of recent investigators of Gastropod embryology. I preface my account of the origin of the several pairs of ganglia with a short description of the epithelium of an embryo at the corresponding stage of development.

The epithelium of the young and still spherical embryo consists, with the exception of four regions of the body which will be mentioned forthwith, of large cubical cells, the protoplasm of which is only very slightly stained by the reagents employed by me (alum-carmine and hæmatoxylin). On both sides of the wide oral opening, however, the epithelium is composed of close-packed cylindrical cells, which are considerably smaller and at the same time relatively elongate, and take a deep stain; these regions of the body therefore appear by condensed light as two oval, subsequently reniform, sharply circumscribed disks, the "*sensory plates.*" Behind the oral region, corresponding to the subsequent ventral surface, there extends a roundish area, the cells of which are entirely similar to those of the sensory plates; this disk of cells soon projects as a blunt cone: it is *the earliest rudiment of the foot.* Bordering upon this, and extending on to the dorsal surface, we find a similar circular disk of cells—*the rudiment of the mantle, with the shell-gland.*

In the course of the further development the whole of the super-

ficial epithelium of the body, with the exception of the portion lying above the mouth—the subsequent "*cephalic vesicle*"—becomes transformed, owing to active multiplication of cells, into a tissue composed of little cylindrical elements.

The cerebral ganglia arise from the epithelium of the sensory plates in the form of solid proliferations, which separate from their matrix and soon become connected by a strong commissure lying above the fore-gut. Soon after this has taken place the sensory plates bud outwards on each side into three blunt papillæ, and so form *the earliest rudiments of what are subsequently the two tentacles and the oral lobes. The epithelium of the rudiments of the tentacles gives origin by proliferation to the tentacular ganglia*, while soon after the separation of the cerebral ganglia from the epithelium of the sensory plates the latter give rise to yet other structures, which subsequently come to have relations with the cerebral ganglia, and possess the highest interest for us. These structures are the "*cerebral tubes*:" I shall deal further with them below.

Simultaneously with the cerebral ganglia *the two pedal ganglia arise in a precisely similar way from the epithelium of the foot-plate*, and soon become connected together by commissures as well as by connectives with the corresponding cerebral ganglion of each side.

It is not until later that a third pair—*the visceral ganglia*—appear. *They arise by proliferation of epithelium in the neighbourhood of the orifice of the two primitive kidneys*, and after separating from the epithelium lie beneath the hind-gut; they become connected by commissures with each other and with the corresponding cerebral ganglion of each side. At this stage of development therefore the nervous system of the Pulmonata exhibits a surprising agreement with the typical disposition seen in many Lamellibranchs, e. g. *Unio* or *Cyclus*, while the central nervous system of the perfect snail (*Clausilia* or *Limax*) exhibits much more complicated and apparently quite different arrangements. How these are produced in the course of further development, how the separate parts become displaced from their relative positions, will be explained in my detailed work; in the present paper a short outline only is given. In the comparison of the embryonic with the fully developed nervous system of the Pulmonata, that which at once strikes us and at the same time renders more difficult the comparison of the latter with the nervous system of the Lamellibranchs, is the circumstance that the separate constituents of the central nervous system, the various ganglia, are much more complicated in structure in the adult snail, have apparently quite a different position with reference to one another, are partly fused together, or at any rate touch one another, and thus surround the foremost section of the intestinal tract as a single mass. They are therefore situated quite at the anterior end of the body, while in the embryo the several pairs of ganglia—corresponding to the primitive arrangement in the mussels—are quite distinct and imbedded in widely separated regions of the body. The following is probably the explanation of this apparent difficulty:—After the several pairs of ganglia have separated in the embryo from the epithelium of the surface of the body and have

become connected together by means of commissures they form an integral system of organs, the further development of which proceeds quite independently of the increase in size and, in different regions of the body in consequence of unequal growth, of the different expansion of the external contours of the body. In the embryo the visceral and pedal ganglia are relatively widely separated from the cerebral ganglia, with which they are united by relatively long commissures. All ganglia rapidly increase in size, while the commissures uniting them together do not increase in length in the corresponding ratio. It follows that a gradual approximation of the ganglia must result from this, until, as the ganglia continue to increase in volume, they finally come into contact with one another, while at the same time the various ganglia continually recede further from their place of origin, the surface of the body, which is rapidly extending in all directions.

We have already briefly alluded to the "cerebral tubes," structures which arise from the sensory plates after the formation of the rudiments of the cerebral ganglia, and which subsequently come into important relation with the central nervous system. They are developed in this way:—*Soon after the separation of the cerebral ganglia a sac-shaped invagination of the epithelium of the sensory plates takes place on each side below the ocular tentacle, and, growing continually deeper, finally comes into contact with the cerebral ganglion of the corresponding side,* though it still has for some time a communication with the exterior by means of a long canal. The duct of this "*cerebral tube*" subsequently closes, and loses its connexion with the external epithelium; the structure then lies, as a thick-walled vesicle, upon the cerebral ganglion. While the lumen of the vesicle gradually becomes narrower, and finally disappears entirely, an active multiplication of cells takes place in its walls, and at subsequent stages of development we find the primitive "*cerebral tube*" *transformed into a roundish mass, which is completely fused with the corresponding cerebral ganglion*; nevertheless the limits of the structure can still be determined with certainty, since its small constituent elements take a much deeper stain than those of the cerebral ganglia.

These structures, the "*cerebral tubes,*" were discovered and their true importance recognized by Messrs. P. and F. Sarasin (*cf.* their "Entwicklungsgeschichte der *Helix Waltoni*, Reeve," in the 'Ergebnisse naturw. Forsch. auf Ceylon,' i. Bd. Heft 2, 1888).

In the tropical *Helix* examined by the above-mentioned authors two "*cerebral tubes*"—the structures were thus designated, and I have accepted the term—were found on each side, and in this respect therefore *Helix Waltoni* differs from *Clausilia* and *Limax*. As regards the *phylogenetic importance* of these peculiar organs, the view taken by Messrs. Sarasin appears perfectly justifiable:—*The cerebral tubes of the Gastropods correspond to the various organs described as cephalic pits, nuchal organs* ("Nackenorgane"), *&c. in many Annelids, and to the cephalic pits of the Nemertines.*—*Sitzungsberichte der Naturforscher-Gesellschaft bei der Universität Dorpat*, Bd. ix. Heft 2, 1891, pp. 277–282.

The Development of Daphnia *from the Summer Ovum.* By J. Lebedinsky, Assistant at the University of Odessa.

There are very few memoirs dealing with the embryology of the Cladocera. Some of them have merely an historic interest*; the others deal with nothing more than the external form of the embryo at different stages, without giving any further details about the internal processes of development†. The best treatise on the development of the Cladocera is that by Dr. Grobben‡, whose observations were made upon *Moina*. Grobben arrived at very important results, which still serve as a basis for certain general theoretical considerations on the laws of heredity. But even Grobben's excellent investigations still left gaps in the facts of the Cladoceran development; of the formation of the shell-gland our knowledge is merely problematical, of that of the heart it is *nil*; in the same way the segmentation and "the origin of the separation of the germinal layers in the blastosphere stage" still await the requisite elucidation.

My investigations have been carried out upon *Daphnia similis*, Cls. The animals were kept in aquaria, and deposited their ova at the temperature of an ordinary room. The summer ovum of *Daphnia similis* is perfectly spherical and ·125 mm. in diameter; it is enclosed in two membranes, the outer of which is a chorion, the inner a vitelline membrane. The contents of the ovum consist of (1) protoplasm, and (2) nutritive yolk. The latter is composed of fat- and albumen-globules of different sizes, exhibits a concentric arrangement, is of a green or blue colour, and renders the ovum perfectly opaque. In every ovum there is found a large fat-globule, always excentric in position, around which other smaller ones are grouped. The protoplasm occupies a central position in the ovum, and is represented by an amœboid cell with lobulate nucleus, which very greedily assimilates the surrounding yolk, increases in size, and multiplies.

Segmentation is superficial. The protoplasm alone divides; no furrows appear on the surface of the ovum, and the subjection of the nutritive by the formative yolk during segmentation does not take place. The amœboid cell separates off a lump of plasma, which lies at the periphery of the ovum, and in which a large vesicle-shaped nucleus can be recognized; the lump of plasma is a directive vesicle (according to Weismann and Ishikawa). The protoplasmic amœboid cell, maintaining as before a central position, divides into two equal daughter-cells, and each of these in a similar way again divides into two, and so on. At stage 8 the directive vesicle is still present; but subsequently it is no longer recognizable. I was not able to determine what becomes of it.

* Jurine, Histoire des Monocles, 1820.

† Zaddach, 1854; Leydig, 1860; Metschnikoff, 1866; P. E. Müller, 1868; Dohrn, 1870; Claus, 1876.

‡ Grobben, Die Entwicklung der *Moina rectirostris*, 1879.

The progeny of the protoplasmic amœboid cell multiply by division, and travel from the centre of the ovum to its periphery; only very few of them remain in the interior, surround the large excentric fat-globule, and disintegrate the fat- and albumen-globules. A small number only of the cells which travel out to the periphery of the ovum actually emerge at a few points on its surface; many of them merely approach the periphery and then undergo active multiplication, whereby the limits of certain cells become confluent and thus form "plasmodia," in which the nuclei are accumulated in heaps and form groups or nests.

Both the cells which have gained the surface of the ovum, as well as those forming plasmodia, undergo further division, and, as the former extend over the surface of the ovum, while the latter emerge thereon, constitute a continuous *blastodermal layer*. The cells of the blastoderm are everywhere similar in size and form, and the ovum has now reached the *blastula* stage. On further development the cells of one half of the ovum become columnar, while those of the other half retain a cuboid shape. The columnar cells form an elongated streak—the *primitive streak*, and the ovum enters upon the stage of the *polar blastula*. The embryo now exhibits bilateral symmetry; we can trace the dorso-ventral plane, and distinguish the ventral and dorsal sides of the embryo, but the anterior and posterior ends of it are as yet alike undistinguishable. At a further advanced stage the flattish cells in the median line near one end of the dorsal side of the embryo become columnar, and we get a local blastodermal thickening, which constitutes an apical plate: with the appearance of this latter organ we are in a position to distinguish the anterior end of the embryo, and to fix the position of all the other regions. In this *completely bilateral stage* the embryo retains, as before, a perfectly spherical shape, but its diameter is now greater.

The germinal layers are formed by invagination. The blastopore is a slight hollow, below which there lie a very few amœboid cells, which slowly sink into the yolk. Although I have made a number of preparations of this stage, I have never succeeded in discovering merely a hollow before the separation of the cells, but always found the hollow, with the cells lying beneath it. I never once detected the process of mitosis in the cells of the hollow; this is very difficult to observe on account of the small size of the nuclei.

The cells which underlie the hollow together constitute the meso-endoderm, which soon differentiates into two separate and independent germinal layers. The *endoderm* takes the shape of a solid cord, in which the cavity subsequently appears, and the two ends of which abut upon the rectum and the œsophagus. The rectum, as well as the œsophagus, arises as an invagination of the ectoderm: the former lies behind the blastopore, the latter in front of it, opposite the apical plate. The whole of the endoderm-cells do not take part in the formation of the mesenteron; some of them spread over the nutritive yolk, and form two large symmetrically placed provisional hepatic sacs.

The *mesoderm* spreads forwards from the blastopore, exhibiting two symmetrical mesodermal bands running towards the ventral surface.

The *shell-gland* arises as a double heap of mesodermal cells, which histologically, as well as in size, are clearly distinguishable from the surrounding cells. The two heaps of cells lie near the second pair of maxillæ, symmetrically placed with regard to the median line. Each heap subsequently becomes transformed into a vesicle, and sends out a hollow process which grows towards the second pair of maxillæ, and there meets with the ectodermal invagination.

The *heart* in its earliest stage appears as a collection of mesodermic cells; the peripheral cells subsequently form a single-layered epithelial cardiac wall, which encloses the cardiac cavity with the cells lying centrally within it.

As regards the *generative organs*, I arrived at no definite conclusion as to their origin; this much, however, I can positively affirm,—(1) there are no special genital cells, which were already present in the early stages of segmentation, and (2) the rudiments of the generative organs are not to be detected even in the Nauplius stage.

I reserve for the present any account of the development of the nervous system.

Note.—The ova and embryos were stained with borax-carmine, hæmatoxylin, and methylene blue, and each stage was examined in longitudinal and transverse sections.—*Zool. Anzeiger*, xiv. Jahrg. no. 362, May 4, 1891, pp. 149–152.

Note on Euherrichia, *Grote.* By A. G. Butler.

When commenting upon Grote's genus *Herrichia* in the last number of the 'Annals' (p. 73) I was not aware that in his 'Revised Check-list' the name *Euherrichia* had been proposed to supersede it: although not characterized and without a specified type, this name will very likely be claimed to have priority over one of my recently characterized genera; but, as it is probable that the *Eriopus granitosa* of Guenée is generically distinct, I would suggest that (this being the case) it should stand as the type of *Euherrichia*.

Antilope triangularis, *a new Genus.* By R. Lydekker.

In writing an article on African Antelopes I have found it very inconvenient to refer to the antelope described by Dr. Günther as *Antilope triangularis* under that generic name, and I therefore think it advisable to suggest the new name *Doratoceros* (which I believe to be unoccupied) for the animal in question.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 45. SEPTEMBER 1891.

XXIII.—*Remarks on the Structure of the Hand in* Pipa *and* Xenopus. By Dr. Hector F. E. Jungersen, of Copenhagen.

In examining the hands of the two above-named Batrachians, it will soon be obvious that the distinctly pronounced difference between the dorsal and volar sides met with in other Anurans is here obliterated; in both genera the tubercles and warts usually characterizing the volar surface are absent. This fact, together with the great similarity of the fingers, renders it difficult to understand the hand correctly, as at first sight the inner fingers are undistinguishable from the outer, and it is not clear which is the upper and which the lower side. From the following it will appear that hitherto all observers of *Pipa* and most observers of *Xenopus* have been misled and have misinterpreted the hand in these animals in one or both respects.

As is well known, the hand in all Anurans has four fingers (II–V), the two innermost of which (II and III) in nearly all the Phaneroglossa are provided with two phalanges, the two outer with three *; also in Aglossa

* Exceptions were first pointed out by Peters (Reise nach Mossambique, iii. 1882), and lately Boulenger ("Note on the Classification of the Ranidæ,"

(*Pipa* and *Xenopus*) we find two neighbouring fingers with two phalanges, the two others with three, a fact easily seen on bending the fingers in any specimen preserved in spirit: but whether the two-articulated fingers really are the inner ones as in Phaneroglossa may seem open to doubt if the examination is confined to the exterior alone; closer examination of the skeleton will, however, soon dispel any doubt.

Pipa.

The coalescence of the bones of the forearm in this genus is more complete than in other Anurans, but still the position of radius and ulna is easily distinguished, and so it will be seen that the three-articulated fingers really belong to the ulnar side. The lower end of the radius is broader than the corresponding end of the ulna, and provided with an expansion of the inner edge; the whole forearm is strongly compressed, with sharp ulnar and radial edges, its lower end being strongly concave behind and rather convex in front.

The *carpus* has all its constituents ossified, but the interspaces between some of the pieces are filled with connective tissue. In the proximal series it contains two bones of very different size. The ulnar (figs. 1, 2, and 4, $u+c_5$) is by far the greater of all the carpal bones: proximally it carries a large articular surface for the ulna and also another smaller, but still considerable, for a part of the radius; distally it is provided on the outer side with a rounded head for the metacarpale V, and consequently it extends through the whole carpus; towards its inner (medial) side are two converging articular faces—one superior, smaller, for the radial piece, the other inferior, larger, for the carpal bone ($C+c_2$). The fore side is concave, but rises towards the outer edge, nearly opposite to the groove that separates the ulna and the radius, into a large process (x), in which some of the muscles of the arm are inserted, and muscles for the dorsal flexion of the fingers take their origin; on the hinder face the bone in question is also concave, and is here, under the sharp edge of the ulna, provided with a heel-shaped process (y), smaller and in a

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Proc. Zool. Soc. 1888, p. 204) has shown that the genera *Cassina*, Gir., *Hylambates*, A. Dum., *Rappia*, Gthr., *Megalixalus*, Gthr., *Rhacophorus*, Kuhl, *Chiromantis*, Peters, *Ixalus*, Tsch., and *Nyctixalus*, Bouleng., have a small bone intercalated between the outermost phalange and that which otherwise is the penultimate, so that the fingers are provided with 3, 3 4, 4 (and the toes with 3, 3, 4, 5, 4) phalanges.

lower position than that of the fore side; a glance at fig. 4 will make this plainer than any description could.

The radial bone of the carpus is considerably smaller, irregularly wedge-shaped, on the fore side somewhat convex, on the hind face concave, and has on the upper side an oval articular facet for the inner (medial) part of the radius, and

Fig. 1.

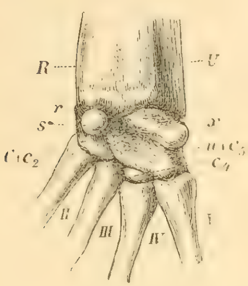


Fig. 2.

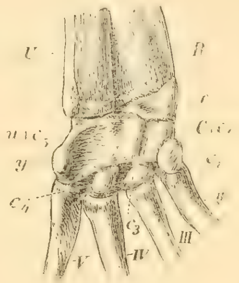


Fig. 3.

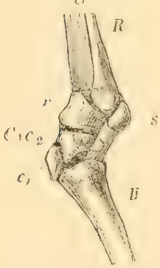


Fig. 4.

Left hand of *Pipa*. Fig. 1 seen from the dorsal side; fig. 2 from the volar side; fig. 3 from the radial, fig. 4 from the ulnar side.
R, radius; U, ulna; *r*, radiale; $u+c_5$, the coalesced ulnare and carpale 5; $C+c_2$, the coalesced centrale and carpale 2; c_1, c_3, c_4, carpalia 1, 3, and 4; *s*, sesamoid bone; II–V, metacarpalia II–V. In fig. 3 the ligament between the sesamoid and metacarpale V is seen.

projects in a free point behind the latter bone (*cf.* figs. 2 and 3); distally it is provided with a large facet, articulating partly with the great ulnar bone, partly with the underlying carpal bone of the lower series, $C+c_2$; when seen from in front the radial carpal bone is nearly hidden by a rounded little bone (*s*), resembling a small patella, which lies just before the junction of the two proximal pieces and undoubtedly represents a sesamoid bone.

In examining the distal series of the carpus from the dorsal side only two pieces are seen, viz. a small oval carpal bone

(c_4), which carries the fourth metacarpal and above joins the great ulnar bone, and a larger radial carpale, $C+c_2$, which carries metacarpale II, and by means of a very little facet partly also metacarpale III; but if the carpus is seen from behind (fig. 2) the distal series presents four pieces (in addition to the lower part of the great ulnar bone), which, counting from the ulnar side, are: carpale 4, which seen from this side is larger and projects somewhat heel-shaped and joins a small, rounded carpale 3, not visible from the dorsal side; the bone $C+c_2$; and finally, articulated with the latter and distally also with the metacarpale II, a still smaller oval bone, which, in spite of its looking like a sesamoid, I regard as a true carpal bone (c_1). Thus the whole carpus of *Pipa* consists of 6, or, if we include the sesamoid bone (s), of 7 discrete bony pieces.

If we compare the statements of previous authors with the above, rather considerable differences are met with.

In the osteology of *Pipa*, prefixed as an explanation of the plates to the first volume of the well-known work of F. G. Schneider *, we find the following description:—"Ossa carpi 7, unum maximum polygonum in *latere interiore* cujus ad latus *externum* duo minora, sed tertium *inferius* magis adhæret. In secunda serie quatuor minora, quorum maximum versus *exteriora*." Thus the number is correct, but, as is shown by the words in italics, Schneider has mistaken the outer for the inner side and *vice versâ*, and confounded the volar and dorsal faces. When these facts are remembered, the other statements will be recognized as quite true (*cf.* my figures); Schneider's own figure (*l. c.* tab. ii fig. 3) is poor and does not agree with the text, presenting only one carpal, the ulnar "maximum polygonum."

F. W. Breyer † adds nothing of his own to our knowledge of the carpus; but his two plates show that he shares in the views of Schneider, the hand in both being turned round, *i. e.* with the underside upwards, while the arm is in the right position, as also is the process x of the great ulnar carpale (at m on tab. i., at n on tab. ii.), which is distinctly given, while the other carpal bones are indistinctly and rather incorrectly represented.

F. T. Meckel ‡ says:—"Bei der *Pipa* . . . . finden sich nur sechs, in zwei Reihen stehende Knochen. Die erste

* 'Historia Amphibiorum naturalis et literaria,' Jena, 1799, 1 Bd. Tabularum ære expressarum interpretatio, p. 262.

† 'Observationes anatomicæ circa fabricam Ranæ Pipæ,' Berl. 1811 (the dissertation is "præside Rudolphi," and thus it is often regarded as a paper of the latter author).

‡ 'System der vergleichenden Anatomie,' 2 Th., 1 Abth., 1824, p. 459.

enthält zwei. Der *vordere* ist der bei weitem grösste, breit, kurz, und scheint aus dem ersten und zweiten des ersten und dem ersten der zweiten Reihe bei den übrigen ungeschwänzten Batrachiern verwachsen zu sein, indem es den Mittelhandknochen des *ersten* Fingers trägt. Von den vier Knochen der zweiten Reihe ist der *vorletzte* der grösste, der *vierte* * liegt ausser der Reihe, der *erste*, *zweite* und *dritte* tragen den *zweiten*, *dritten* und *vierten* Mitthelhandknochen." The number 6 is thus obtained by Meckel in leaving out of consideration the little bone, which I regard as a sesamoid (*s*) ; the italic words in his description show that he falls into the same error as Schneider.

C. Mayer † describes the carpus as follows :—" In einer hinteren Reihe 1. das sehr grosse *os naviculare* ‡, welches alle übrigen *ossa carpi* zusammengenommen an Masse übertrifft. Es steht rückwärts mit dem vereinten Knochen des Vorderarms und vorwärts mit dem *os metacarpi* des *ersten* Fingers, mit dem *os capitatum* § und *os hamatum* ‖ in Verbindung. 2. Das *os lunatum* ¶ steht mit dem *os antibrachii*, mit dem *os naviculare* und *pisiforme* **, nach vorwärts mit dem *os hamatum* in Verbindung. 3. Ein *os pisiforme*, mit dem *os lunatum* articulirend. In der vorderen Reihe : 4. das *os hamatum*. Es steht in Verbindung nach vorwärts mit den *ossa metacarpi* des *dritten* und *vierten* Fingers. 5. Ein besonderes Knöchelchen, frei liegend, mit dem *os hamatum* verbunden, kann als *hamus* desselben betrachtet werden ††. 6. Das *os capitatum* steht in Verbindung mit dem *os metacarpi* des *zweiten* Fingers ‡‡." The nomenclature, which is taken from human anatomy, as well as the numbering of the fingers, proves that Mayer, like his predecessors, confounds the radial and the ulnar sides ; in interpreting c_1 as "*hamus*," he seems to recognize the true volar side, but this it is difficult to reconcile with his principal error and with his interpretation of *s* as "pisiforme." The existence of the little carpale 3 is evidently not noticed by Mayer, so that his giving 6 as the number of carpalia is incorrect ; in a later publication §§ he says, however, that in *Pipa* (*Asterodactylus*) " sechs oder sieben " carpalia are found.

* c_1 in my figs. 2 and 3.

† "Beiträge zu einer anatomischen Monographie der *Rana Pipa*," Nov. Act. Acad. C. L.-C. Nat. Cur. vol. xii. p. 2, 1825, p. 6 (532).

‡ $u+c_5$ in my figures. § c_4. ‖ $C+c_2$. ¶ *r*. ** *s*. †† c_1.

‡‡ Mayer's first, second, third, and fourth fingers are thus really the fifth, fourth, third, and second.

§§ 'Analecten für vergleichende Anatomie,' p. 34.

We come next to Brühl *, who in the tab. p. xxv, in fig. 11 A, represents the "Vorn- (Dorsal-) Sicht des linken Carpus und seiner Nachbarstheile;" the carpal bones are tolerably well given, setting aside that the markings of the surfaces are rather indistinct; the radial and ulnar sides are rightly distinguished, and consequently also his numbering of the metacarpals and their carpals is correct †; but nevertheless Brühl commits an error, quite as grave as that of his predecessors, having confounded the dorsal and volar sides, and besides mistaking the right hand for the left! His figure really represents, as will immediately appear on comparing it with my figure 2, not the fore side of the left hand but the hind side of the right.

Exactly the same mistake is found in the latest publication on the carpus of the Anurans by G. B. Howes and W. Ridewood ‡, whose figure 1 on pl. vii. is supposed to represent the left hand from above of an adult *Pipa*, ♂, and fig. 2, the left hand of a very young specimen with the carpus not yet ossified, but in reality both show the right hand seen from the volar side. Hence these authors describe the sesamoid *s* as lying ventrally (*l. c.* p. 162), place the process x of the great ulnar carpale $u+c_5$, the "postaxial lobe" (* in their figure 1), behind the ulna, and find the coalesced bones of the forearm in a quite exceptional position, the outer edge of the ulna being "directed dorsally. As the result of this, the radius comes to lie in the plane of the extended hand, while the ulna lies above it." In reality the forearm is essentially in the same position as in other Anurans, *i. e.* when the plane of the carpus is directed from right to left, then the plane of the forearm is placed obliquely to the former, with the radial edge turned forwards and inwards, the ulnar edge backwards and outwards; only this torsion of the forearm is still more strongly marked than in other Anurans; and the carpus, moreover, forms an obtuse angle with the forearm, especially apparent when the arm is seen from the radial side (*cf.* fig. 3). Howes and Ridewood quote of previous authors Breyer, Meckel, and Mayer; but they seem not to have been aware of the mistakes of these authors, and give the two papers of Mayer as by two different authors. Of special interest is their observation that the bone *s* is wanting in a

* 'Zootomie aller Thierklassen,' Atlas, tab. p. xxv (1876).

† c_1 of my figures is regarded by Brühl as not belonging to the carpus, and is named "radio-sesamoideum;" the sesamoid *s* he seems not to know at all.

‡ "On the Carpus and Tarsus of the Anura," Proc. Zool. Soc. 1888, p. 141.

young specimen of 19 millim. length, and thus its nature as a sesamoid seems to be proved; moreover, they have shown that the bony piece c_1 is preformed in cartilage like the true carpalia, and originally without connexion with metacarpale II; thus its interpretation as a true carpal bone would seem to be accepted by others besides "Daumen-Enthusiasten" (Brühl). The process x is said to be wanting.

That Brühl, Howes, and Ridewood, though they rightly distinguish the radial and ulnar sides, yet confound the dorsal and volar sides, seems to be explained by the singular form of the metacarpals (*cf.* below); the confounding of the right and left fore limbs is a mere consequence of the first error, and would be easily intelligible if the observers had only had to do with isolated limbs. This seems partly to have been the case with Howes and Ridewood, as they (*l. c.* p. 143) mention having received limbs of *Pipa* from Prof. Wiedersheim; but besides they have examined a large male and a complete young specimen, and this being the case I am not able to account for their mistake.

As to the question how the carpals of *Pipa* are to be understood and named, we first meet with the difficulty that the interpretation of the anuran carpus is not at all universally settled, and secondly that *Pipa* in several points is somewhat exceptional.

Generally the proximal series of the anuran carpus consists of two bones, which Gegenbaur * regards as radiale and ulnare; in the distal series there may be one piece to each metacarpal, called by Gegenbaur carpalia 1–5, as in *Xenopus*, where all the bones are well developed (*cf.* figs. 5, 6, p. 205); but most frequently the number of these pieces is reduced through coalescence (e. g. in *Hyla*, *Rana*, *Bufo*, &c., the metacarpalia III–V being here carried by one carpale); and finally on the radial side there is generally interposed a larger piece, interpreted by Gegenbaur as a dislocated centrale; in some cases it extends upwards beside the radiale and joins the radius, so that it seems to belong to the upper series, which consequently would acquire the three pieces typical to most vertebrates; this junction with the radius, however, is of secondary nature and is wanting in younger stages, so that the proximal series really contains but two bones. Concerning the ulnar bone, all authors agree as to its corresponding to the ulnare; its constant position outside a branch of *arteria*

* Unters. zur vergl. Anat. des Wirbelthiere: "Carpus und Tarsus," 1864.

brachialis, as in Urodela and some Reptiles, puts the correctness of this view beyond doubt. As to the radial bone opinions differ: Gegenbaur supposes the intermedium to have disappeared, and regards it as the radiale, as already stated; on the other hand, it is interpreted by Born * as intermedium, and the centrale of Gegenbaur as radiale, partly because he thinks he has found another centrale in some *Alytes* and *Pelobates* larvæ, partly because the disputed centrale in some cases joins the radius. Howes and Ridewood, however, have confirmed (*l. c.* p. 159) that it does not originally belong to the proximal series, and besides made it less probable that any importance is to be ascribed to Born's centrale; they use the indifferent name lunatum, but state that this must be either radiale or radiale + intermedium; the centrale of Gegenbaur is named naviculare and regarded as a *radial* centrale. Emery † thinks that the proximal-radial bone is the coalesced radiale and centrale, and that Gegenbaur's centrale belongs to the distal series as a "carpale præpollicis," because he thinks he has found in a *Pelobates* larva a trace of a sixth finger on the ulnar side, whence that finger, which generally is regarded as the first, in his opinion becomes a "præpollex;" the second to fifth fingers are reckoned as first to fourth. Moreover, Emery finds in a group of closer-set cellules in the tissue between the cartilaginous ulnare and radiale in larvæ of *Rana esculenta* "ein nicht mehr verknorpelndes Intermediumrudiment."

In opposition to Emery, however, I may say that in the larval hands of *Bombinator* and *Rana platyrrhinus*, which I have examined, partly through section-cutting, partly in clove-oil, I have not been able to find any trace of a finger on the ulnar side of that which I, in accordance with most authors, have named the fifth, nor have I seen anything like a rudiment of an intermedium; moreover, I feel convinced that Emery has misinterpreted the preparation on which his fig. 1 (*l. c.* p. 285) is founded: *s* is not "scaphoideum (carpale præpollicis)," but either carpale 2 or carpale 1; *ce* is scaphoideum (auth.), *i. e.* centrale of Gegenbaur, which does not at all coalesce with *r* (radiale), but in later stages appears on the lateral border of the carpus.

As to the interpretation of the *distal* series of the anuran carpus, I may add that Howes and Ridewood do not admit

* "Nachträge zu 'Carpus und Tarsus,'" Morphol. Jahrb. 6 Bd. 1880, p. 61.

† "Zur Morphologie des Hand- und Fussskelett's," Anat. Anz. 5 Jhg. 1890, p. 283.

that the bone which carries metacarpale V is carpale 5, because they have found in a single species (*Xenophrys*) a small cartilage (said even to ossify in old specimens) in the ligament which extends from carpale 4 to metacarpale V, also seen in *Bombinator* and *Discoglossus*, which cartilage (or ligament) they regard as the true carpale 5, while they interpret the latter bone as an ulnar centrale; thus the hand would possess two centralia, both dislocated towards their respective sides of the hand. In a *Bombinator*-larva having the fore limbs yet included in the gill-cavity, but the outer side of the forearm and the two outer fingers coloured, I have not found any trace of this ligament, and it seems to me very improbable that two centralia should be greatly developed and still both lie out of their primitive position. On the whole, I am unable to admit that the later investigations have made it necessary to give up the interpretation due to Gegenbaur; therefore I have followed him, and I have named the carpal bones in *Xenopus* (*cf.* figs. 5, 6, p. 205) in accordance with his views. Now, in comparing *Pipa* with the latter, the reductions met with in *Pipa* will be easily explained. It is thus quite certain that the great ulnar bone in *Pipa* consists of the coalesced ulnare and carpale 5, for in *Xenopus* we recognize the process x on the ulnare, and the process y on carpale 5; besides, the above-mentioned artery, which in *Xenopus* is seen at a, runs in *Pipa* in a groove under a projection of the great ulnar carpale, carrying the articular face for the radius, and mesially to this artery we find the two articular faces where the pieces r and $C+c_2$ join, but in *Xenopus* r and C articulate with c_5. Hence it follows that r in both genera is the same bone, radiale. The bone in *Pipa* which carries metacarpale II is in all probability the coalesced centrale and carpale 2; closer examination will show a trace of a process answering to the large process on C in *Xenopus*, and this being the case the bone in question contains at any rate the centrale, and I see no reason why the carpale 2 should have quite disappeared.

Howes and Ridewood have also interpreted the just-mentioned bones in a similar manner; whereas Brühl, without further ceremony, designates the bone $C+c_2$ as the carpale 2, making no remarks as to the absence of our centrale (Endodiacarpale or Endo-radiocarpale of Brühl).

The *metacarpals* in *Pipa* do not seem to have attracted the special attention of previous authors, probably because their form apparently corresponds very well with the supposed volar face, but undoubtedly the mistakes are mainly due to the singular form of these bones. Metacarpale II is

curved a little inward (radially), and besides at its base feebly convex towards the back of the hand; that is to say, it is not unlike the corresponding bone in *Rana*, except in its long and slender form. A similar form is possessed by the outer metacarpal, Mc. V, only it is curved towards the ulnar side; on the contrary, metacarpale III and metac. IV, although at their bases a little concave on the underside, are rather strongly curved, with the *convexity towards the palmar side*; so that the whole hand seems to have the back concave and the palm convex. As the bases of metacarpale II and metac. V project over the level of the two middle metacarpals, the two outer fingers can be turned inwards over the middle fingers; and such being the case, the hand seems still narrower and its back looks still more concave. All the metacarpals are long and slender; the two middle ones are about equal in length, but are somewhat longer than the outer, which are also nearly of equal length. Of the fingers the innermost (II) is shortest, the penultimate (IV) longest; next comes the third (III), and last the outer (V); the number of the phalanges is 2, 2, 3, 3 (counting from the radial side), as typical in Anurans.

That the earlier authors gave wrong descriptions of the fingers was due to the mistakes above mentioned. Thus Schneider says (*l. c.* p. 262):—"*Externi* digiti articulos 2, ante penultimi itidem 2 ut tertii, *intimi* 3 numeravi, quibus adhæret pars extrema aculeata. Sed pedum anteriorum articulos extremos agnoscere accurate non licuit, præfractis plerisque mucronibus." The figure shows the fingers incorrectly and does not agree with the text. Breyer only refers to his figures, of which that on tab. i. represents three phalanges in all the fingers and the shortest finger towards the outer side; that on tab. ii. gives the correct number, but the hand, as stated above, is turned so that the inner finger comes to lie on the outer side. Meckel (*l. c.* p. 466) says concerning the Anurans:—" Der zweite und dritte Finger haben im allgemeinen zwei, die beiden aüsseren drei Glieder. Doch hat *Pipa* an den drei inneren drei, am *äussersten* nur *zwei*." And later on: " Im allgemeinen ist der zweite vollkommene Finger (eigentlich also der dritte) der bei weitem kürzeste, der darauf nach aussen folgende der längste: bei *Pipa* dagegen ist der *zweite* der längste." Mayer makes no remarks about the fingers; but in the work of Duméril and Bibron * (who do not go into the osteology of the hand) we read:—" Le *second*

* 'Erpétologie générale,' t. viii. p. 775.

doigt est le plus long des quatre, après lui c'est le troisième, ensuite le premier, puis le *dernier,* qui est par conséquent le plus court." Thus here also we meet with the common mistake.

Of the old authors Bonnet * *perhaps* observed the correct numbering of the fingers ; he says ". . . leur longueur étoit inégale. Le *troisième* qui étoit le plus long . . . . ;" but whether he really had a clear idea of the hand cannot be decided either from his text or figures.

If we now make an examination of the exterior of the hand we shall observe the following facts: the back of the hand is concave, the palm convex, and the outer fingers can be turned inwards over the middle ones, so that the hand acquires the peculiar narrow form which is often seen in specimens preserved in spirit and which certainly will be found in the living animal. The distribution of colour that in Anurans usually very distinctly characterizes the lower and upper sides is here but feebly marked; yet I have found among the specimens which I had the opportunity of examining a few in which the colour was paler and spotted, like the belly, on the inner side of the arm as well as on the upper side of the wrist and the three inner metacarpals; besides, the skin on the back of the hand is often somewhat smoother and finer than on the palm. That a hand like this is used very little for walking seems evident; the absence of tubercles from the palm points in the same direction. Unfortunately we know nothing as to the mode of locomotion in the genus *Pipa*, our information concerning the habits of this animal being very scanty; the old and hitherto (as far as I know) the only observers of the animal in the living state (Miss Merian and Dr. Fermin) merely noticed its singular mode of breeding. Probably *Pipa* will be found essentially aquatic in its habits. Miss Merian † only says that it dwells on a plant growing in the water. Fermin ‡ states that it lives in the swamps of the thick forests, and that the specimens he kept were almost constantly swimming about, and scarcely ever sat quietly at the bottom.

* "Observations sur le *Pipa* ou Crapaud de Surinam," Journal de Physique, t. xiv. 1779, p. 427.

† 'De generatione et metamorphosibus insectorum Surinamensium,' Amstelod., 1710, p. 70.

‡ 'Abhandlungen von der Surinamischen Kröte &c.,' übersetzt v. Goeze. Braunschweig, 1776.

Xenopus.

The structure of the hand in this genus is mentioned by but few authors. Mayer (‘Analecten,’ 1835, p. 34) simply says about *X. lævis* (Daud.) “Der Carpus besteht aus fünf bis sechs kleinen Knöchelchen,” and makes no remarks concerning the skeleton of the fingers. The accompanying figure of the whole skeleton in his work (which is with some additions due to Schlegel) is rather incorrect both as regards the carpus and the fingers, the latter being assigned the following number of joints, 2, 3, 3, 2. From the relative length of the fingers and from the description of the exterior of the animal (*cf. l. c.* tab. ii. fig. v.) it is evident that the hand is turned with the inner side outwards and the palm looking upwards. Mayer says (*l. c.* p. 29), “Es sind vier Finger vorhanden, wovon der *zweite innere* um eine halbe Linie länger ist als die übrigen;” in reality this applies to the penultimate finger. Hallowell *, in his description of *Xenopus* (*Dactylethra*) *Mülleri*, Peters, says, “. . . fourth finger stoutest, *second longest*, first and fourth of nearly equal length;” thus he falls into the same error as Mayer. A. Duméril † figures the hand correctly in *X. calcaratus*, Peters; but as the text is no improvement on Hallowell’s description of the fingers in *X. Mülleri*, with which Duméril holds his species to be identical, the correctness of the figure is apparently due to the artist. Peters ‡, in his diagnosis of the genus *Xenopus*, rightly observes “Die Zahl der Phalangen der Finger 2, 2, 3, 3 und der Zehen 2, 2, 3, 4, 3 ist die gewöhnliche;” but in the beautiful pictures of his *X. Mülleri* (*l. c.* tab. xxv.) he still depicts the lower side of the hand in that figure which represents the animal seen from above (fig. 3), and the upper side of the hand in fig. 3 *a*, representing the lower side of the animal. Howes and Ridewood (*l. c.* p. 163, pl. vii. fig. 4) have given the first and hitherto only complete representation of the carpus (*X. lævis*); but they have here made the same mistake as in *Pipa*, figuring the right hand from behind, while they believe they have represented the left hand from the dorsal side. This is especially evident from their referring to “the great expansion of the head of the fourth metacarpal,” a peculiar feature

* “Notice of a Collection of Reptiles from the Gaboon Country, West Africa,” Proc. Acad. Nat. Sci. Philad. 1857, t. ix. p. 65.

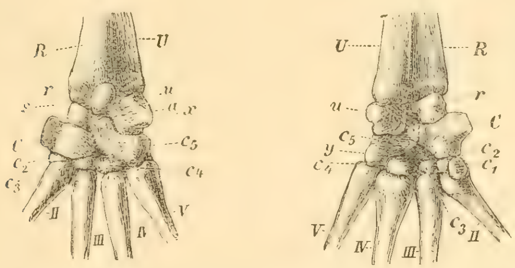
† “Reptiles et Poissons de l’Afrique occidentale,” Arch. du Muséum d’Hist. nat. t. x. 1858–61, p. 231.

‡ ‘Reise nach Mossambique,’ Zool. iii. Amphibien, 1882, p. 180.

which cannot be seen from the dorsal side of the hand, on account of the outer metacarpals lying at a higher level than the middle ones, and thus being able to move inwards over the middle fingers, as in *Pipa*: moreover these authors must have regarded the sesamoid bone (represented in dotted lines *l. c.* fig. 4) as ventral in *Xenopus* as well as in *Pipa*, otherwise they would have pointed out its different position; in the skeleton which I have examined it touches the radius only, while Howes and Ridewood have found it lying in the line of junction between the ulna and radius.

Owing to this error in confusing the ventral and dorsal sides of the hand in *Xenopus*, and as the figure of Howes and Ridewood does not depict the surface of the carpal bones, though it is of some value for comparison with *Pipa*, I have thought it best to give fresh figures without entering into further details as to the single bones.

Fig. 5. Fig. 6.



Left hand of *Xenopus lævis* (Daud.). Fig. 5 seen from the dorsal side, fig. 6 from the volar side. R, radius; U, ulna; *r*, radiale; *u*, ulnare; C, centrale; c_1–c_5, carpalia 1–5; II–V, metacarpalia II–V; *s*, sesamoid bone.

The *metacarpals* and the *fingers* are very slender; the metacarpals, of which the middle ones are the longest, are neither so long nor aberrantly curved as in *Pipa*: of the fingers the penultimate (IV) is the longest, next comes the outer (V), then the third (III), and the innermost (II) is shortest; but the difference in length is rather small, so that at a first glance they seem almost equal. In most Anurans the distribution of the colour on the fore limbs is very characteristic, the side looking towards the body being pale, as is the back of the hand, except the two outer fingers (IV, V), which are coloured; the same condition is partly seen in *Xenopus*, especially in *X. lævis*, where I have found the back

of the hand pale except the outer finger, while the lower side of the hand has the colour of the outer side of the arm. Boulenger * seems to be the only author who has hitherto understood the hand in this animal correctly, having had the opportunity of observing it in the living state; he has noticed the position of the hand with the fingers superposed, the inner fingers only touching the ground, and the colourless condition of the inner (*i. e.* upper) side, though he has not remarked that in the latter respect this frog resembles most others. A most interesting addition to the brief biological account given by Boulenger we owe to Leslie †, who states that *X. lævis* is essentially aquatic in its habits, that it, unlike other frogs, feeds only in the water and forces its prey into its mouth by means of its hands, which act as a pair of claspers ‡; its mode of locomotion on land is by difficult and awkward crawling and leaping, and when at rest it never assumes a sitting posture, and the back never appears humped. Even Leslie has made a slight mistake, saying that in the breeding male "the *palmar* surface and inner side of the fore-arm acquire a black horny layer;" this structure is found on the *back* of the hand, as is the case with our frogs and toads.

XXIV.—*On the Arrangement and Inter-relations of the Classes of the Echinodermata.* By Prof. F. JEFFREY BELL, M.A.

HAVING recently had to attempt the formulation of exact diagnoses of the various living classes of the Echinodermata, I have been led to consider closely the claims of the present current classification into Pelmatozoa and Echinozoa. The moment we look at the matter from the phylogenetic point of view we find ourselves involved in a very maze of difficulties. Are the stalked derived from the unstalked forms or *vice versâ*? If the group Echinozoa is natural, how intimate are the relations of the Holothurians to the other skeleton-bearing forms with remnants at least of a calycinal area? What are the points, other than the non-fixed condition, which unite

* Proc. Zool. Soc. Lond. 1887, p. 563.

† "Notes on the Habits and Oviposition of *Xenopus lævis*," Proc. Zool. Soc. Lond. 1890, p. 69.

‡ Perhaps the great process on the centrale, the process *x*, &c. are connected with this peculiar use of the hands; and it is probable that we shall some day learn that *Pipa* behaves in a similar way.

the groups of the Echinozoa among themselves? Are some of the so-called Cystidea nearer to Crinoids than others are to Echinoids? Unless the Holothurians are primitive forms, how is one to imagine the means by which they reacquired their primitive (or more worm-like) characters? The "Cystids" are undoubtedly primitive, and yet how can that condition be shown in any scheme of classification which separates them from the Holothurians? And, finally, how with current views, can one draw up exact, consistent, and inclusive diagnoses?

Forced by considerations of this kind to examine afresh the classification of Echinoderms, I have been led to some conclusions which I should like to have an opportunity of putting—and I will do it as concisely as I can—before those who are interested in questions of this kind. In the preparation of my notes I have been greatly aided by the knowledge and criticism of my colleagues, Mr. F. A. Bather and Mr. J. Walter Gregory, of the Geological Department of the British Museum, which have been freely extended to me; various faults, both of omission and commission, have in consequence been avoided; for such as remain in this paper I must ask to be alone responsible.

In what follows I do not propose to cite to any extent the names of those numerous writers who have in the last decade reopened various questions in the systematic or phylogenetic classification of the Echinodermata; for the facts with which I am going to try and defend what is new in the classification to be proposed are all perfectly well known. It is only in the way of looking at them that there is, I imagine, anything novel.

(a) *The Relation of the Holothurioidea to the rest of the Echinodermata.*

The following characters seem to be of weight:—

1. There is no system of plates corresponding to those that form the "calycinal area" in other Echinoderms; hence the group may be said to be non-caliculate.

2. The genital apparatus is not disposed quinqueradially; in all other Echinoderms the gonads are either arranged along the rays or, when they fuse, in the interradii—they may, in a word, be said to be *actinogonidiate*, whereas the Holothurian, with its bilaterally symmetrical or asymmetrical gonad, is *anactinogonidiate*.

These two characters appear to me to be of very great

significance; it would be interesting to discover to what extent they are correlated. Although the Holothurian is as truly actinoneural and actinangiote as any other Echinoderm, this actinism, so frequently pentameric in character, has not influenced the generative system. For the moment we will leave open the question whether this is a primitive or a secondary character. We can well imagine that the development of a calyx—early acquiring, *Tiarechinus* would lead us to suppose, a large size,—if itself actinal in arrangement, would do much to impress actinism on all the systems of the body.

However, be that as it may, Holothurians are non-caliculate and anactinogonidiate, and so far they differ from all other Echinoderms known to us.

3. The musculature of the body-wall is well developed and consists of longitudinal and circular muscles; the latter may be brought so far under the influence of actinism that they are not continuous as in *Synapta*, but are broken at the rays.

Like all other characters, this must either have been inherited or secondarily acquired; we may be sure that an ancestor of the Echinoderms possessed it, so that the Holothurians have either inherited it or their ancestors lost it and they reacquired it. Between these probabilities it is not, I think, difficult to make a choice.

4. There is a system of infundibular organs which it is hard to imagine are not the homologues of the nephridia of many Vermes. Or

5. There is a system of cæcal outgrowths from the proctodœum which recall the proctodœal cæca of *Bonellia* and other Gephyrea.

Recent researches in the morphology of the nephridial systems of Vermes, and especially Mr. Beddard's discovery of anal nephridia in *Acanthodrilus multiporus*, are sufficient to justify the speculation that the Vermian ancestor of the Echinoderm was provided with a diffused nephridial system, of which it is justifiable to suppose part was inherited by the Synaptidæ and part only by the other Holothurians.

6. The water-vascular system is always continued into circumoral tentacles, but not always into those similar structures on the body generally which may be called podia *; so far, and *pace* Prof. Ludwig, there is an apodous and a pedate stage among Holothurians.

* It can only be due to the unfortunate habit of using cumbrous periphrases that the name suggested by Bronn ('Thierreichs,' ii. p. 383) has not been adopted; it is the least objectionable of any proposed name for the tube-feet.

7. The specialized "heart," "ovoid gland," or "plexiform gland" is not developed.

This, if the Holothurians are primitive among the Echinoderms, was only to be expected.

8. The larva is simple, and, on the whole, the mode of reproduction is less complicated than in other classes.

The position, then, that the Holothurians are primitive forms is spoken to (1) by the possession of characters certainly possessed by its ancestor, and (2) by the absence of characters seen in other Echinoderms, and evidently differentiations of structures developed after the ancestor of the Echinoderm had become separated from the ancestors of other phyla *.

(b) *The Relations of the remaining Echinodermata among themselves.*

But while Holothurians are non-caliculate and anactinogonidial, all other Echinoderms are caliculate and all that we know are actinogonidial. Considering the irregularity of the actinism of some Cystids, such as, say, *Atelecystis Forbesi* or *Caryocystis*, we may reasonably suppose that some of them were anactinogonidial. We have then caliculate and non-caliculate groups, and of the former there were in all probability some that were anactinogonidial.

The pelmatozoic condition, to which Leuckart was the first to draw attention, was by him regarded as the actual or potential possession of a stalk; but this connotation has become altered. By Pelmatozoa we have recently meant

* The argument from habitat is not of itself of much value, but it may have a cumulative force, coming after those which I have already adduced; and the fact that Holothurians have been found in brackish water may fairly be stated thus—they are not so differentiated as to be unable to live in any medium other than salt water. The ancestors of our existing archaic forms must surely have dwelt along a shore-line such as that described by Dr. von Kennel ('Arbeiten aus dem zool.-zoot. Inst. in Würzburg,' vi. p. 276):—"In diesem Wasser nun, für dessen Qualität als Süsswasser ich freilich keine anderen Kriterien habe, als den Pflanzenwuchs und das Gefühl der Zunge, da ich leider keine Analysen ausführen lassen konnte, herrscht ein merkwürdiges Thierleben. Zahllose Frosch- und Krötenlarven bedecken in schwarzen Klumpen den Boden oder hängen an den Wasserpflanzen, Unmassen von Mückenlarven verschiedener Gattungen schwimmen theils frei, theils sitzen sie an der Unterseite der Blätter und Steine, die im Wasser liegen, Libellenlarven und Wasserkäfer, sowie kleine Tauchwanzen, tummeln sich lebhaft herum, und mitten darunter ebenso massenhaft, wenn nicht in grösserer Zahl, Mysis, Nereiden und kleine Quallen, zusammen mit Palaemoniden und eine kleine Atyaart, zu schweigen von den kleinen rhabdocoelen Turbellarien, &c."

Echinoderms fixed by their aboral pole. It is among the Caliculata only that the question of pelmatozoism arises.

But it is the next to be faced, for, although the Holothurians exhibit clear signs of affinity with the primitive Echinoderm derived from a generalized worm, the "Cystids" show no less definitely that they are extremely archaic forms. It is stated by Barrande that *Lichenoides* had no stalk, and there is a general agreement among students of the group that there were some of the so-called Cystids that were never fixed and had not fixed ancestors. In other words, there were apelmatozoic and pelmatozoic Cystids.

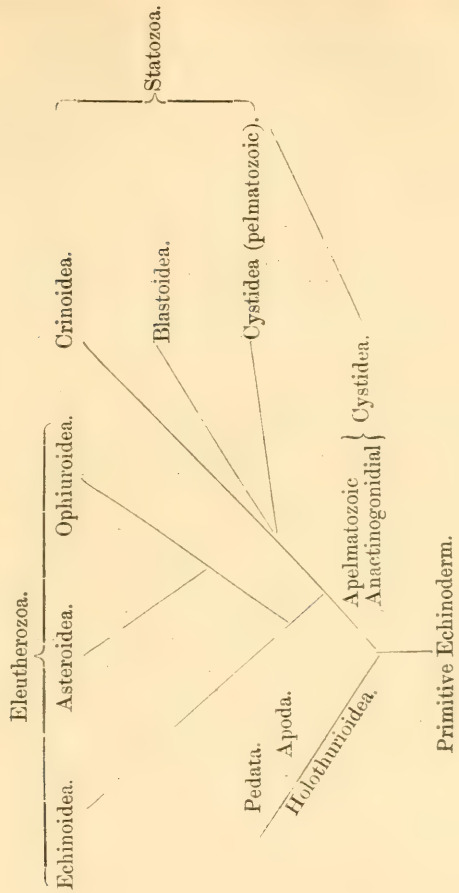
Pelmatozoic	Actinogonidial.		Cystidea.
Apelmatozoic			Cystidea.
Anactinogonidial.		Holothurians.	Cystidea.
		Non-Caliculate.	Caliculate.

The relations of the forms are shown objectively in the accompanying table. The rearrangement of the Cystidea has long been recognized as a serious want.

The apelmatozoic actinogonidial Cystids divide into two main branches: one leads to the strictly pelmatozoic forms, that is forms that were fixed or had ancestors that were fixed; the other leads to the Echinoidea, Asteroidea, and Ophiuroidea; the former may be called the Statozoa, the latter the Eleutherozoa.

Of the relations *inter se* of the pelmatozoic series I propose to say nothing more *; but there remain a few generalizations to be made regarding the rest, or the Echinozoa in the sense of some authors. When, however, we have said that they are apelmatozoic and actinogonidial (which is also true of some of the other series), we have said about all that is true of them, save that they are eleutherozoic. When we come to see in what they differ we cannot find sufficient justification for their union under the common name Echinozoa, as a mark distinguishing them from all other Echinoderms.

* I suppose no morphologist will be bold enough to say whether *Marsupites* or the irregular Blastoids are primarily or secondarily free forms.



Phylogeny of the Echinodermata.

The typical arrangement in an Echinoid is that the ambulacra extend from the mouth to the boundaries of the calycinal area; in Asteroids and Ophiuroids the great development of additional plates causes the ambulacra to be confined to the oral aspect of the body. I am unable to find a very satisfactory term for this arrangement, but I propose, provisionally at any rate, to speak of it as zygopodous in the Urchin and azygopodous in the Starfish. Whatever we do, we must be careful not to use the term brachiate; for the arms (brachia) of a Crinoid are formed by addition to the

free edge, but those of an Asterid or an Ophiurid by intercalation between the radial and the terminal.

The Stelleridea then of earlier writers are marked by the common character of being azygopodous; for a time, no doubt, the Stellerid descendant of the apelmatozoic Cystid was neither distinctively Asteroid nor Ophiuroid; and at this stage I imagine one should place those fossil Stellerids whose exact systematic position is a matter of such difficulty.

Bnt it is no less clear that the Asteroid and Ophiuroid types of organization are very different; in one the organs of the body have radial extensions, in the other there is a concentration of the viscera comparable to that seen in the external conformation of the body: in the one the radial extensions are grooved beneath and the ambulacral ossicles are mere serial repetitions, which remain as independent of their neighbours as the nature of the case permits; in the others there is a marked tendency towards a solidification of the arm, the ossicles are articulated to their neighbours, and the physiological unity of each arm becomes marked.

When looked at as a whole, and I may be permitted to point out that it is long since the classes of Echinoderms have been thus critically considered, the essential characters of the groups of Echinoderms are seen to be somewhat different from those which systematists have been in the habit of using. It is in the hope that this general view has led to a more correct appreciation than is possible when one class alone is considered that I bring these generalizations and speculations before those who are interested in the problem.

Put in the ordinary linear way the proposed arrangement will read thus :—

Branch A. INCALICULATA.

Stage *a*. ANACTINOGONIDIATA.

Class. 1. *Holothurioidea.*

Branch B. CALICULATA.

Stage *a*. ANACTINOGONIDIATA.

Class 2. Some *Cystidea* (?).

Stage *β*. ACTINOGONIDIATA.

1st Sub-branch. *STATOZOA.*

Sub-stage i. Apelmatozoic.

Class 3. ? " Some *Cystidea*."
Class 4. ? Some *Crinoidea*.
Class 5. ? Some *Blastoidea*.

Sub-stage ii. Pelmatozoic.

Class 6. *Crinoidea* (s. s.).
Class 7. "*Cystidea*."
Class 8. *Blastoidea* (s. s.).

2nd Sub-branch. *Eleutherozoa*.

Division i. *Zygopoda*.

Class 9. *Echinoidea*.

Division ii. *Azygopoda* (s. *Stelleridea*, s. em.).

Class 10. *Asteroidea*.
Class 11. *Ophiuroidea*.

Precision will be given to our ideas if concise definitions of these various groups are given.

The Echinodermata are Metazoa Cœlomata in which bilateral symmetry is early or altogether lost, but may be secondarily acquired; it is generally replaced by a quinqueradial disposition of nearly all the parts. The integument and some of the internal organs are strengthened by a crystalline deposit of carbonate of lime, mesodermal in origin, plexiform in structure; this may remain microscopic and spicular, or part may form macroscopic rods or plates or give rise to a continuous skeleton. A section of the cœlom becomes modified into a special system of sacs, canals, and tubes, which form the water-vascular system, and have an ambulatory or respiratory function, or both. The sexes are generally separate, and development is rarely direct.

They are almost exclusively marine in habit.

The Incaliculata are Echinodermata in which no system of plates set alternately along and between the rays is developed in the aboral region.

The Anactinogonidiata are Echinodermata in which the vascular and nervous, but not the digestive or reproductive, systems exhibit quinqueradiate symmetry.

The Caliculata are Echinodermata in which the skeleton is always, in part at least, formed of plates, some of which are set in rows, alternately radial and interradial, round a single central plate.

The Actinogonidiata are caliculate Echinodermata in which

the generative organs are radial in position or have undergone fusion and become interradial.

The Statozoa are actinogonidiate caliculate Echinodermata in which the oral surface of the body looks upwards, the body is temporarily or permanently fixed, the podia have a respiratory function only, and the anus opens on the oral surface. They may (pelmatozoic) or may not (apelmatozoic) have or have had a stalk.

The Holothuroidea are non-caliculate, anactinogonidial, apelmatozoic Echinoderms, in which the skeletal system is spicular or irregular; the musculature of the body-wall is well developed, and the mouth is surrounded by a circlet of never very numerous tentacles communicating with the water-vascular system; this is or is not provided with podia. The mouth and anus are at or near the opposite ends of a generally elongated body. A few are hermaphrodite and a few have been found in brackish water.

The Eleutherozoa are actinogonidiate caliculate Echinodermata in which the oral surface of the body looks downwards, the power of locomotion is retained, and the podia are often locomotor in function; the anus, if present, varies in position.

The Zygopoda are Eleutherozoa in which the podia extend more or less uninterruptedly from the calycinal to the oral region.

The Azygopoda are Eleutherozoa in which the podia are all or nearly all on the oral surface of the body only, and are separated by terminal plates from any contact with the calycinal area.

The Echinoidea are caliculate, actinogonidial, eleutherozoic, zygopodous Echinoderms, in which the calycinal area may be very extensive, reduced, or greatly metamorphosed; the gonads are unpaired and interradial; the body is perfectly rounded, more or less flattened, or bilaterally symmetrical, and is more or less covered by spines which may be long, stout, and strong, or present every stage of reduction to such as are fine and silky. They are all proctuchous, but the anus is not always opposite the mouth. Respiration partly by gills and partly by the podia, which may be specially modified.

The Asteroidea are caliculate, actinogonidial, eleutherozoic, azygopodous Echinoderms, in which there is an open ambulacral groove. The stellate form of the body is often well marked and the rays prolonged into "arms," which vary in their proportional length to the diameter of the disk. The digestive system, which is rarely aproctous, and the genera-

tive share in the stellate disposition of the organism. Pentameric repetition is more often exceeded in this than in any other class, and asexual reproduction from a part of the body is by no means uncommon. Respiration diffuse.

The Ophiuroidea are caliculate, actinogonidial, eleutherozoic, azygopodous Echinoderms, in which there is no distinct ambulacral groove. The "arms" are sharply marked off from the disk, are very rarely more than five in number, and are sometimes elaborately branched. The digestive system, which is aproctous, and the generative are confined to the area of the disk, as is also the specialized respiratory apparatus, which takes the form of deep clefts.

The Crinoidea are caliculate, actinogonidial, statozoic Echinodermata, provided with branching articulated arms. In a number of forms the stalked condition is larval only or it is altogether lost; the power of locomotion is often reacquired. The aboral nervous system is highly specialized. Gonads developed in the arms. Five or more water-pores establish a communication between the cœlom and the exterior.

It is not necessary for the purpose I have in view to offer definitions of the Cystidea or Blastoidea; perhaps a palæontologist will oblige.

XXV.—*Descriptions of some new* Geophilidæ *in the Collection of the British Museum.* By R. I. Pocock.

[Plate XII.]

Geophilidæ.

Henia athenarum, sp. n. (Pl. XII. fig. 1.)

Colour ochraceous; head and maxillipedes darker.

Body robust, more attenuate anteriorly than posteriorly.

Head small, wider than long, wider behind than in front, with convex sides; frontal plate indistinct.

Antennæ of moderate length, filiform, evenly thick throughout, shortly hairy, the segments narrower at their base, the apical segment ovate and longer than the penultimate.

Maxillary coxæ wide, narrowed posteriorly, chitinous lines conspicuous and complete, the anterior border crescentically excavated; *feet* short and stout, not attaining, when

shut, the frontal margin, covered laterally by the head, unarmed; *pleuræ* large when viewed from below, when seen from above appearing in the angle formed where the head meets the basal plate.

Prebasal plate invisible; *basal plate* wide, about four times as wide as long, as wide as the head and first tergite, but not so long as the first tergite, its sides subparallel and lightly convex.

Tergites bisulcate, broader and twice as long as the prescuta.

The *pleural prescuta* large and free, larger than the tracheal sclerites, which are in contact with the tergites.

Sternites neither sulcate nor carinate, except the first and last furnished with a conspicuous, median, circular, porous area, those at the anterior end of the body granular, the rest scarcely, or at least inconspicuously, granular.

Anal somite.—*Tergite* wide, wider than long, with converging and convex sides, almost covering the pleuræ; *pleuræ* small but not coxiform, smooth and without pores; *sternite* wider than long, as long as the pleuræ, with converging sides, mesially impressed; prosternal pieces conspicuous; *legs* short, about as long as the preceding pair, composed of five segments, and unarmed.

Number of pairs of legs 103.

Length 70 millim.

A single specimen from Athens.

I can see no reasons for separating *Scotophilus* * from *Henia*. The species that Meinert described as *Scotophilus* appear to be only well-marked species of *Henia*. In length of body and number of legs this species comes between *H. devia* of Koch and Meinert's species.

Geophilus Grantii, sp. n. (Pl. XII. fig. 2.)

Colour testaceous, head and maxillary segment pale castaneous.

Body much narrowed posteriorly.

Head considerably longer than wide, with straight anterior and posterior borders and convex lateral borders, shining and more or less indistinctly punctured; frontal plate indistinct.

Antennæ longish, hirsute, attenuate, the segments subcylindrical, the last segment not longer than the penultimate.

Prebasal plate invisible; *basal plate* with its posterior

* This name in any case cannot stand, since it is preoccupied for a bat.

border narrower than the anterior border of the first tergite, its lateral margins strongly converging.

Maxillary coxæ wide, lightly depressed longitudinally in the middle line, sparsely punctured, without a trace of chitinous lines, the anterior border notched; the feet not long, largely overlapping the head at the sides, but scarcely overlapping it in front, the joint of the claw falling short of the anterior angles of the head; the femoral segment armed internally with one small tooth, the following two segments obsoletely armed, the claw unarmed.

Tergites smooth, shining, bisulcate, more than twice as long as the prescuta.

The *tracheal sclerites* in contact with the tergites and much smaller than the prescutal sclerites.

Sternites in the anterior end of the body with a posterior median porous area and an anterior median depression; in the middle of the body with a median longitudinal depression and lightly depressed at the sides; at the posterior end of the body without depressions.

Anal somite.—*Tergite* not covering the pleuræ at the sides; *pleuræ* very small and coxiform, without pores; sternite wide, much wider than long, with lateral margins strongly converging posteriorly and posterior margin straight; the prosternal sclerite very large and conspicuous.

Legs considerably longer than those of the preceding somite, hairy, composed of six segments, unarmed, or, at most, armed with a very minute claw; much thicker in the male than in the female.

Number of pairs of legs, in ♂ 55, in ♀ 57.

Length 38 millim.

Two specimens from Madeira, collected by my friend and colleague Mr. W. R. Ogilvie-Grant, to whom I have great pleasure in dedicating the species.

This species is remarkable for the smallness of the anal pleuræ.

Geophilus challengeri, sp. n. (Pl. XII. figs. 3, 3 *a*.)

Colour testaceous, with pale castaneous head.

Body posteriorly attenuate, smooth and sparsely hairy.

Head short, only a little longer than wide, obsoletely punctured, posterior border straight, lateral borders nearly straight, convex only in front and behind.

Antennæ of moderate length, attenuate, the apical segment not larger than the penultimate.

Prebasal plate visible; *basal plate* long and wide, more

than half as long as the head and almost as wide posteriorly as the first tergite, its sides strongly converging.

Maxillary coxæ wider than long, largely covered posteriorly on each side by the episternal plates, without chitinous lines, the anterior border lightly excavated; the *feet* unarmed, largely overlapping the head at the sides, but not in front, being short, with the joint of the claw considerably behind the anterior angle of the head.

Tergites, except the first and a few at the posterior end of the body, bisulcate; prescuta of normal size.

Tracheal sclerites in contact with the tergites and smaller than the prescutal pleural sclerites.

Sternites at the anterior end of the body with a median porous area, in the middle and at the posterior end without porous area and not depressed or sulcate.

Anal somite.—*Tergite* narrowed behind, not covering the pleuræ; *pleuræ* small, hairy, but not porous, or at most only porous beneath the margin of the sternite; *sternite* hairy, moderately wide, its sides strongly converging posteriorly; *legs* very hairy, short and thick, only a little longer than those of the preceding somite, the two proximal segments almost fused together and very much thickened, the second, third, and fourth segments posteriorly excavated beneath, the margins of the excavation thickly hairy; terminal segment not armed with a claw.

Number of pairs of legs 73.

Length 59 millim.

A single male specimen from St. Vincent, one of the Cape-Verde Islands, collected by the officers of H.M.S. 'Challenger.'

This species is very distinct and may be recognized by its five-jointed anal legs, by the thickness of the two proximal segments, and by the excavations on the under surfaces of the second, third, and fourth segments of these same appendages. These characters may, however, belong only to the male sex.

Geophilus parthorum, sp. n. (Pl. XII. figs. 4, 4 *a*.)

Colour ochraceous; head pale castaneous.

Body robust, attenuated anteriorly and posteriorly, but more posteriorly than anteriorly.

Head a little longer than wide, punctured; frontal plate indistinctly defined.

Antennæ composed of 14 segments, moderately long and stout, nearly naked, hairy on the inner surface in the proximal

half, the segments subcylindrical, the fourteenth segment (? apical) the same size as the thirteenth, truncate and hollowed distally.

Prebasal plate visible; *basal plate* as wide posteriorly as the maxillipedes, its sides strongly converging, its anterior border lightly concave.

Maxillary coxæ punctured, wider than long, narrowed at the antero-lateral angles, without chitinous lines, the anterior border feebly excised; the *pleuræ* seen from below large; *feet* punctured, short, stout, largely overlapping the head at the sides, but only attaining the frontal border, unarmed internally.

Tergites, except at the anterior and posterior ends of the body, bisulcate, smooth, at most lightly wrinkled and punctured; prescuta a little narrower than the tergites; pleural prescuta large, larger than the tracheal sclerites, which are in contact with the tergites.

Sternites punctured, with a median longitudinal impression, without defined porous area.

Anal somite.—*Tergite* narrowed behind, not covering the pleuræ; *pleuræ* without pores above in their posterior half and below along their free margin, the rest of the surface furnished with many (about forty) round pores; *sternite* narrow, twice as wide in front as behind, with the margins lightly convex in front; prosternal plates visible; *legs* pubescent, short, a little longer than the preceding pair, composed of six segments, unarmed, stout in the male. Anal pores visible.

Number of pairs of legs 69.

Length 73 millim.

A single specimen from Samarkand.

In the structure of its head this species presents some resemblance to *G. carpophagus*, Leach (=*sodalis*, Mein., *condylogaster*, Latz.), which is common in Europe; but the head in *G. parthorum* is narrower. Moreover the anal somite is very different. The antennæ of the specimen described appear to be imperfect, although they are composed of 14 segments.

Geophilus sydneyensis, sp. n. (Pl. XII. figs. 5, 5 *a* and *b*.)

Colour ochraceous throughout.

Body nearly parallel-sided, sparsely hirsute.

Head convex from side to side, a little longer than wide, with convex sides and straight posterior margin, wider in front than behind; frontal plate indistinctly defined.

Antennæ slender, nearly parallel-sided, the segments a little narrowed at the base; the apical segment ovate, nearly twice as long as the preceding one.

Prebasal plate invisible; *basal plate* large, wide, but not four times as wide as long, its sides distinctly converging, as wide posteriorly as the first tergite and wider than the head.

Maxillary coxæ long, convex, narrowed posteriorly, chitinous lines distinct and long, the anterior margin straight and not toothed; *pleuræ* large; *feet* stout, short, when closed not overlapping the head in front, posteriorly overlapping it at the sides, all the segments unarmed.

Tergites bisulcate; prescuta long and about as wide as the tergites.

Pleural prescuta large, much larger than the tracheal sclerites, which are in contact with the tergites.

Sternites mesially impressed, without distinct porous area.

Anal somite.—*Tergite* wider than long, much narrowed posteriorly, not covering the pleuræ; *pleuræ* moderately large, entirely smooth; *sternite* very wide, twice as wide as long, its sides strongly converging posteriorly; prosternal plates distinct; *legs* short, about as long as the preceding pair, composed of six segments and armed with a claw; in the male very much thicker than in the female. Anal pores indistinct.

Number of pairs of legs 43.

Length 18 millim.

Three specimens (2 ♂ and 1 ♀) from Inner Double Bay, Port Jackson, Australia, collected by Mr. J. Brazier.

This species is from the same locality as *G. concolor*, but differs from it in having a much smaller number of legs, in having short, unarmed maxillipedes, smooth pleuræ, &c.

Geophilus (?) *laticeps*, sp. n. (Pl. XII. figs. 6, 6 *a*.)

Colour pale testaceous throughout.

Body wide and flat, a little narrowed posteriorly, but more narrowed anteriorly.

Head about as wide as long, convex, with lightly rounded sides, a little narrower anteriorly.

Antennæ about twice the length of the head, thick, very slightly incrassate, the segments a little narrowed at the base, in the distal half of the appendage a little wider than long, the apical segment large, ovate, as long as the two that precede it.

Prebasal plate invisible; *basal plate* wide, about four times

as wide as long, as wide as the head and the first tergite, its sides lightly convex and a little converging anteriorly.

Maxillary coxæ long, wider in front than behind, narrowed at the antero-lateral angles, with complete chitinous lines, the anterior border lightly concave, without teeth; *pleuræ* seen from below large; *feet* short and stout, not overlapping the head in front when closed, but overlapping it a little at the sides, all the segments unarmed.

Tergites twice as long and a little broader than the prescuta, marked with two distinct sulci and with a less distinct median sulcus.

Pleural prescuta large, larger than the tracheal sclerites, which are in contact with the tergites.

Sternites, at least in the anterior third of the body, marked posteriorly with a transversely elongate porous area; the rest marked with a median impression.

Anal somite.—*Tergite* wide, wider than long, nearly covering the pleuræ, narrowed posteriorly; *pleuræ* small but not coxiform, entirely smooth; *sternite* wide, wider than long, its sides strongly converging; prosternal plates distinct; *legs* short, about as long as and a little thicker than the preceding pair, slender (in ♀), composed of six segments and armed with a claw.

Number of pairs of legs 59.

Length 26 millim.

A single female specimen of this species from King Island, in Bass Strait (S. Australia), collected and presented to the British Museum by Mr. Arthur Dendy.

This species cannot be confused with any that have been hitherto described from Australia. It is, in fact, so different from all that perhaps a new genus should be created for its reception.

[*Geophilus morbosus* (Hutton). (Pl. XII. figs. 7, 7 *a*.)

Syn. *Himantarium morbosum*, Hutton, Ann. & Mag. Nat. Hist. (4) xx. p. 115 (1877).

Colour ochraceous, with pale castaneous head and maxillary somite.

Body posteriorly attenuate.

Head much longer than wide, wider in front than behind, sparsely punctured; frontal plate indistinctly defined.

Antennæ hairy, attenuate, segments narrower at the base, the apical ovate and a little longer than the penultimate.

Prebasal plate invisible; *basal plate* very small, about half the width of the first tergite, its sides strongly converging.

Maxillary coxæ hairy, punctured, as long as wide, mesially impressed, without chitinous lines, anterior margin with two small teeth; the *pleuræ,* seen from below, very narrow; *feet* elongate, punctured, hairy, largely overlapping the head at the sides and in front, the joint of the claw being on a level with the front margin of the head, the femur and claw armed with a small internal tooth.

Tergites bisulcate.

Sternites with median impression and a fainter impression on each side of the middle line.

Anal somite.—Tergite longer than wide, narrowed posteriorly, not covering the pleuræ; *pleuræ* moderately inflated, almost wholly smooth, there being a few pores only close to the edge of the sternite; *sternite* wide, about as wide as long, with convex lateral and posterior borders; prosternal plates distinct; *legs* in female slender, composed of six segments, longer than those of the preceding somite, armed with a claw. Anal pores conspicuous.

Number of pairs of legs 39.

Length up to 43 millim.

The Museum possesses two specimens of this species—one from Wellington (New Zealand), presented by the Otago University Museum, the other ticketed merely New Zealand, presented by Mr. F. E. Beddard.

Dr. Erich Haase, when writing his monograph on the Indian and Australian Chilopoda, overlooked the small paper of Hutton's above referred to. Consequently this species and the one described below are not taken into consideration. Since, however, both the species were very briefly described and referred to wrong genera, the omission is of small importance. Fortunately the types of both these species were acquired by the trustees of the British Museum in 1886, and I have gladly taken this opportunity of describing them as intelligibly as I can.]

Geophilus antipodum, sp. n. (Pl. XII. fig. 8.)

Colour deep ochraceous, head and maxillipedes castaneous; shining.

Body attenuate posteriorly.

Head much longer than wide, narrowed behind, widest in its posterior half just beyond the middle line, posteriorly bi-impressed, sparsely punctured.

Antennæ hairy, attenuate, the apical segment ovate and a little longer than the penultimate.

Prebasal plate invisible; *basal plate* sparsely punctured,

very narrow, about half the width of the first tergite, not twice as wide as long, its sides strongly converging.

Maxillary coxæ punctured, mesially impressed, the antero-lateral angles squared, without chitinous lines, the anterior margin bidentate; *pleuræ*, seen from below, very narrow; *feet* long and slender, punctured, largely overlapping the head at the sides and in front, the joint of the claw being on a level with the anterior angles of the head, the femur armed internally with a blunt tooth, the second and third segments armed with a minute tooth, and the claw armed with a conspicuous sharp tooth.

Tergites bisulcate, wider than the prescuta; pleural prescuta large, free, larger than the tracheal sclerites, which are in contact with the tergites.

Sternites with a stronger median and two weaker lateral impressions.

Anal somite.—Tergite triangular, very much narrowed behind, not quite covering the pleuræ; *pleuræ* smooth above, furnished below with about twelve conspicuous larger and smaller pores, the posterior interior edges of the pleuræ thickened; *sternite* narrow, much longer than wide, its sides strongly converging; *legs* longer than the preceding pair, composed of six segments, armed with a claw, a little thicker in the male; *anal pores* conspicuous.

Number of pairs of legs in male and female 39.

Length up to 31 millim.

Two specimens ticketed N. Zealand, a third from Maungatua presented by Mr. J. Vaughan-Jennings, and a fourth from Wellington (*H.M.S.* '*Challenger*').

This species is closely allied to *G. morbosus*, the two having probably been confounded by Hutton. It may, however, be distinguished at once by its conspicuously porous anal pleuræ and narrow anal sternite.

Geophilus Huttoni, sp. n. (Pl. XII. figs. 9, 9 *a* and *b*.)

Syn. *Himantarium ferrugineum*, Hutton, Ann. & Mag. Nat. Hist. (4) xx. p. 115 (*ferrugineus*, nom. preocc.).

Colour * (*teste* Hutton) entirely pale red, antennæ rather lighter.

Body robust, slightly attenuated posteriorly.

Head a little longer than wide, with straight anterior and posterior margins and lightly convex sides; frontal plate indistinctly defined.

* The colour of the Museum example has been destroyed by exposure to light.

Antennæ (one only remaining) attenuate, short, composed of 12 segments (probably the appendage has been reproduced), the segments constricted at the base; the apical ovate and a little longer than the preceding segment.

Prebasal plate invisible; *basal plate* a little narrower than the first tergite, considerably more than twice as wide as long, its sides strongly converging.

Maxillary coxæ much wider than long, narrowed at the antero-lateral angles, obsoletely punctured, the anterior border emarginate, chitinous lines distinct and complete, but short; *pleuræ*, seen from below, large; *feet* short, stout and unarmed, overlapping the head at the sides, but falling far short of its anterior border.

Tergites, except those at the anterior and posterior extremities of the body, bisulcate and mesially impressed, wider and much longer than the prescuta.

Pleural prescuta large, much larger than the tracheal sclerites, which are in contact with the tergites.

Sternites with a very faint median abbreviated impression, those at the anterior end of the body with an indistinctly defined posterior porous area.

Anal somite.—Tergite very narrow, nearly twice as long as broad, its sides lightly convex and subparallel, not nearly covering the pleuræ; *pleuræ* very large, inflated and long, extending forwards on each side so as to touch almost the whole length of the sides of the tergite of the preceding somite, covered above and below with large pores; *sternite* long and narrow, much longer than wide; *prosternal plates* inconspicuous; *legs* slender in female, a little longer than those of the preceding somite, composed of six segments and armed with a claw; anal pores inconspicuous.

Legs of the other somites shorter and thicker at the anterior than at the posterior end of the body.

Number of pairs of legs 109.

Length 118 millim.

One specimen from Wellington (N. Zealand), presented by the Otago University Museum.

Considering its great number of legs, long body, and short maxillipedes, there is small wonder that Hutton referred this species to the genus *Himantarium*. It is, however, it seems to me, a veritable *Geophilus*, although somewhat abnormally constructed.

This species is evidently very closely allied to *G. polyporus* of Haase, from d'Urville Island (Papua). The form of the anal somite appears to be the same in the two species,

but in *G. polyporus* the maxillipedes project much more beyond the sides of the head.

Geophilus provocator, sp. n. (Pl. XII. figs. 10, 10 *a*, *b*.)

Colour deep ochraceous; head and maxillipedes pale castaneous; shining.

Body robust, posteriorly attenuated.

Head punctured and hairy, a little longer than wide, wider in front than behind; frontal plate indistinctly defined.

Antennæ of moderate length, thick, attenuate, hairy; segments subcylindrical, the apical ovate and a little longer than the penultimate.

Prebasal plate invisible; *basal plate* wide, about three times as wide as long, very nearly as wide as the first tergite, its sides strongly converging.

Maxillary coxæ much wider than long, punctured, the antero-lateral angles not narrowed, chitinous lines absent, front border emarginate, without teeth; *pleuræ*, seen from below, moderately large; *feet* short and stout, overlapping the head at the sides but not in front, the joint of the claw being some distance behind the anterior angles of the head, the femur armed with a single blunt tooth, the other segments unarmed.

Tergites bisulcate, punctured, a little wider than the prescuta.

Pleural prescuta large, free, and much larger than the tracheal sclerites, which are in contact with the tergites.

Sternites in the anterior half of the body with a conspicuous, transversely elongate, porous area in the posterior half, the rest with a median impression, and the posterior end with lateral impressions.

Anal somite.—*Tergite* a little longer than wide, its sides slightly converging posteriorly, not nearly covering the pleuræ; *pleuræ* large, but not extending forwards as in *G. Huttoni*, conspicuous from above, furnished with about seven pores above and with from ten to twenty below; *sternite* longer than wide, twice as wide in front as behind, its sides strongly converging; *prosternal plates* manifest; *legs* longer than those of the preceding somite, thick (in male), hairy, composed of six segments and armed with a small claw. Anal pores inconspicuous.

Number of pairs of legs 69.

Length 59 millim.

Two male specimens in the collection from Wellington (New Zealand), collected by the officers of H.M.S. 'Challenger.'

Geophilus alacer, sp. n. (Pl. XII. figs. 11, 11 *a*.)

Colour ochraceous, with pale castaneous head and maxillipedes.

Body moderately robust and not very markedly attenuate towards the posterior end; very smooth.

Head longer than wide, wider in front than behind, with lightly convex sides and nearly straight anterior and posterior margins, indistinctly and sparsely punctured, and sparsely hairy; frontal plate indistinctly defined.

Antennæ of moderate length, hairy, the segments narrowed at the base, the apical segment nearly twice the length of the penultimate.

Prebasal plate invisible; *basal plate* very small, about a quarter of the length of the head, narrower than the first tergite, with its sides strongly converging, sparsely and indistinctly punctured and sparsely hairy.

Maxillary coxæ subquadrate, the pleuræ, viewed from below, being very narrow, without chitinous lines, the anterior margin bearing two conspicuous teeth; sparsely punctured and hairy; the feet long, considerably overlapping the head-plate laterally and anteriorly, the joint of the claw being about on a level with the anterior border of the head; the claw armed basally with a distinct tooth, the femur with a much smaller blunt tooth.

Tergites sparsely hairy, those in the middle of the body being obsoletely bisulcate.

Tracheal sclerites in contact with the tergites and smaller than the prescutal pleural sclerites.

Sternites without distinct porous area, except those at the anterior end of the body, marked with a median longitudinal groove.

Anal somite.—*Tergite* not quite covering the pleuræ, smooth, narrowed behind; *pleuræ* moderately inflated, smooth above, furnished beneath with seven large pores, of which the two posterior are the largest; *sternite* narrow, longer than wide, its sides posteriorly converging; prosternal pieces small; *legs* a little longer than those of the preceding somite, slender, attenuate, the segments increasing in length from base to apex, armed with a long claw; *anal pores* conspicuous.

Number of pairs of legs 33 in female.

Length 21 millim.

A single specimen from the Straits of Magellan collected by the officers of H.M.S. 'Alert.'

This species is remarkable for its small number of legs, the

only species which it resembles in this respect being, I believe, *G. pusillus* of Meinert, from North Africa. It is undoubtedly very closely allied to the above-described *G. antipodum*, but differs in having a smaller number of legs, in being broader in the head, &c.

EXPLANATION OF PLATE XII.

Fig. 1. *Henia athenarum*, sp. n. Head from below.
Fig. 2. *Geophilus Grantii*, sp. n. Anal somite from below.
Fig. 3. *Geophilus challengeri*, sp. n. Head from above.
Fig. 3 *a*. Ditto. Head from below.
Fig. 4. *Geophilus parthorum*, sp. n. Head from above.
Fig. 4 *a*. Ditto. Anal somite from below.
Fig. 5. *Geophilus sydneyensis*, sp. n. Head from above.
Fig. 5 *a*. Ditto. Head from below.
Fig. 5 *b*. Ditto. Anal somite from below.
Fig. 6. *Geophilus laticeps*, sp. n. Head from above.
Fig. 6 *a*. Ditto. Head from below.
Fig. 7. *Geophilus morbosus* (Hutton). Head from above.
Fig. 7 *a*. Ditto. Anal somite from below.
Fig. 8. *Geophilus antipodum*, sp. n. Anal somite from below.
Fig. 9. *Geophilus Huttoni*, sp. n Head from above.
Fig. 9 *a*. Ditto. Head from below.
Fig. 9 *b*. Ditto. Anal somite from above.
Fig. 10. *Geophilus provocator*, sp. n. Head from above.
Fig. 10 *a*. Ditto. Head from below.
Fig. 10 *b*. Ditto. Anal somite from below.
Fig. 11. *Geophilus alacer*, sp. n. Head from below.
Fig. 11 *a*. Ditto. Anal somite from below.
Fig. 12. *Cryptops atlantis*, Pocock. Anal leg from the side.

XXVI.—*Remarks upon the Genus* Pythina *of Hinds and the Species which have been referred to it, upon* Mysella *of Angas, and the Description of a new Species of* Mylitta. By Edgar A. Smith.

[Plate XIII. A.]

(*a*) On *Pythina*.

The genus *Pythina* was established by Hinds in 1844 for a small triangular bivalved mollusk collected at New Ireland during the voyage of the 'Sulphur,' which is distinguished by a very peculiar kind of surface-ornamentation or sculpture, namely ribs or folds which extend from each end of the valves in an upward direction, meeting and divaricating at the

centre. Nothing is known of the animal of this interesting shell.

As many as nineteen so-called species have been described as belonging to this genus, or have been subsequently placed in it. Some of these do not possess the remarkable sculpture which characterizes the type, and differ also as regards the construction of the hinge. Others agree in having divaricate plications, but exhibit a widely different dentition.

I will now proceed to discuss each of these species, and will indicate the genus to which I think they should be referred.

1. *Pythina Deshayesiana*, Hinds.

1844. *Pythina Deshayesiana*, Hinds, Zool. Voy. 'Sulphur,' vol. ii. p. 70, pl. xix. figs. 8, 9.
1858. *Pythina Deshayesiana*, H. & A. Adams, Gen. Rec. Moll. pl. cxiv. figs. 9, 9 *a*.
1862. *Pythina Deshayesiana*, Chenu, Man. Conch. vol. ii. p. 126, fig. 603.
1878. *Pythina Deshayesiana*, Kobelt, Illust. Conchylienbuch, p. 352, pl. ciii. fig. 3.

Hab. New Ireland (*Hinds*); also Philippine Islands (*Cuming*, fide *Hinds*).

In my report upon the Lamellibranchiata of the 'Challenger' Expedition, p. 204, I have stated that the dentition of this species "is exactly that of *Kellia*" *, and that "the fact of the shell being divaricately plicate does not in my opinion entitle it to generic rank, but may be regarded of subgeneric importance." I have again critically examined this species, with the result that I am able to confirm the above observations, perhaps modifying the last statement respecting the relative value of sculpture in separating genera or subgenera. I am now inclined, in this instance, not to admit that it is even of subgeneric importance.

The dentition of this species is accurately defined by Hinds, H. & A. Adams, and Kobelt; but Chenu, in his 'Manual,' has described the hinge of *Mylitta*, being under the impression that it was synonymous with *Pythina*. Hinds states that the pallial line is without any sinus; and on examining three specimens in the British Museum I find this to be correct, for the regular uninterrupted impression is clearly traceable from scar to scar. On the contrary, the existence of "a slight triangular sinus" is mentioned by H. & A. Adams and Kobelt. This error may have arisen through those authors obtaining their information from the description of *Mylitta* (regarded by them as synonymous with *Pythina*) given by

* Stoliczka has restricted Lamarck's comprehensive genus *Erycina* and made it equivalent to *Kellia* (Palæont. Indica, vol. iii. p. 263).

d'Orbigny and Récluz, and not from actual examination of the species.

The ligament is mainly internal, oblique (as in *Kellia*), and posteriorly inclined and adjacent to the hinder tooth; a narrow linear extension of it borders the hinge-margins between the umbones. The lower internal margins of the valves are minutely denticulate, the denticles being rather stronger at the ends than in the middle. The entire external surface is minutely punctate, like some of the species of *Lepton*; but this feature is only visible under a powerful lens.

2. "*Pythina Deshayesii*, d'Orb. & Recl.," H. & A. Adams. (Pl. XIII. A. fig. G.)

1844. *Erycina Deshayesii*, Récluz, Rev. Zool. 1844, p. 325.
1850. *Myllita Deshayesii*, d'Orbigny and Récluz, Journ. de Conch. 1850, p. 292, pl. xi. figs. 12–14.
1858. *Pythina Deshayesii*, d'Orb. & Recl., H. & A. Adams, Gen. Rec. Moll. vol. ii. p. 476.
1862. *Pythina Deshaysii*, Chenu, Man. Conch. vol. ii. p. 126, fig. 602.
1865. *Pythina Deshayesi*, d'Orb., Angas, Proc. Zool. Soc. 1865, p. 652.
1878. *Mylitta Deshayesii*, Kobelt, Illust. Conchylienbuch, pl. ciii. fig. 11.
1875. *Pythina tasmanica*, Tenison-Woods, Proc. Roy. Soc. Tasman. 1875, p. 162.
1887. *Pythina tasmanica*, Tate, Trans. Roy. Soc. S. Austral. vol. ix. p. 98, pl. v. fig. 12.

Hab. New Holland (*Récluz*), Adelaide (*Brit. Mus.*), Rapid Bay, St. Vincent's Gulf, S. Australia (*Angas*), King's Island, N.W. of Tasmania (*Tenison-Woods*).

The fact of this remarkable shell having divaricate folds doubtless induced Messrs. Adams, Chenu, Tenison-Woods, and Tate to consider it congeneric with *Pythina*. It is quite evident that none of them had an opportunity of comparing the two hinges, or they would at once have perceived the difference. Still it is surprising that Messrs. H. and A. Adams should have made this mistake, for had they compared the description of *Mylitta* * given by d'Orbigny and Récluz with the specimens of *Pythina Deshayesiana* which they figured themselves, or even with Hinds's description of the hinge, they certainly would have held these genera distinct.

I feel convinced that d'Orbigny and Récluz have fallen into an error respecting the pallial impression. After a most careful examination of several valves of this and allied species I cannot discover a trace of the triangular sinus described by them.

* Inaccurately spelt *Myllita*, J. de Conch. 1850, p. 288.

It seems to me likely that an oblique scar across the interior of the valves, such as we find in many species of Lucinidæ, may have deceived them.

At present the systematic position of *Mylitta* is doubtful; but considering the character of the exterior I am inclined to locate it provisionally in the above-named family.

3. *Pythina tasmanica*, Tenison-Woods.

Pythina tasmanica, Tenison-Woods, Proc. R. Soc. Tasman. 1875, p. 162; Tate, Trans. R. Soc. S. Austral. vol. ix. p. 98, pl. v. fig. 12.

Hab. King's Island, N.W. of Tasmania.

This species is identical with the preceding, as indicated in the synonymy.

4. *Pythina Stowei*, Hutton. (Pl. XIII. A. figs. D, E, F.)

1873. *Pythina Stowei*, Hutton, Cat. Mar. Moll. New Zeal. p. 76.
1880. *Pythina Stowei*, id. Manual N. Z. Moll. p. 157.

Hab. Islet Reef, Cook Strait, New Zealand (*Hutton*), New Zealand (*Dr. Sinclair*, in Brit. Mus. 1856).

This is a larger and narrower shell than *Mylitta Deshayesii*, but agrees with it as regards the hinge. It is ornamented with strong divaricate plicæ, the entire surface being minutely shagreened or punctate.

5. *Pythina paula*, A. Adams.

Pythina paula, A. Adams, Proc. Zool. Soc. 1856, p. 47.
Montacuta paula, Smith, Report 'Challenger' Lamellib. p. 203, pl. xii. figs. 1–1 *b*.

Hab. Raine Island, Torres Straits (*A. Adams*), south of New Guinea ('*Challenger*').

This species has neither the dentition nor sculpture of *Pythina*, but agrees in both respects with *Tellimya*. I presume it was placed in *Pythina* mainly from its resemblance in form to the type of that genus and to the fossil *Modiola arcuata*, Lamk., referred to that genus by Hinds himself.

6. *Pythina peculiaris*, A. Adams.

Pythina peculiaris, A. Adams, Proc. Zool. Soc. 1856, p. 47.

Hab. Ceylon.

This so-called species, based on a single specimen in Cuming's collection, I regard as a mere distortion of *P. paula*.

7. *Pythina arcuata*, A. Adams.

Pythina arcuata, A. Adams, Proc. Zool. Soc. 1856, p. 47.

Hab. Zebu, Philippines.

This also, like the two preceding species, has the dentition of *Tellimya*, and should be referred to that group.

8. *Pythina triangularis*, A. Adams.

Pythina triangularis, A. Adams, Proc. Zool. Soc. 1856, p. 47, = *Mactra nucleus* (Conrad ?), Reeve, Conch. Icon. 1854, fig. 102.

Hab. Manilla (*A. Adams*).

This small, almost equilaterally triangular species also has the dentition of *Tellimya*, agreeing in this particular precisely with the type, *T. bidentata*.

9. "*Pythina arcuata*, Lamarck," Hinds *.

Modiola arcuata, Lamarck, figured by Deshayes (Coq. foss. Environs Paris, vol. i. pl. xl. figs. 4, 5, 6), is stated by Hinds to belong to *Pythina*. It forms the type of the genus *Hindsia* of Deshayes, which was afterwards modified, on account of its preoccupation, to *Hindsiella* by Stoliczka. It possibly may be a species of *Montacuta* or *Tellimya*, as it appears to be in external appearance very closely allied to *T. paula* (A. Adams).

10. *Pythina mactroides*, Hanley.

Pythina mactroides, Hanley, Proc. Zool. Soc. 1856, p. 340.

Hab. Cape of Good Hope.

This little species is undoubtedly a *Kellia* both as regards the hinge and the smooth surface of the valves. I presume that Hanley was led to place it in the genus *Pythina* on account of the straight or even incurved ventral margin, which recalls the form of the type, *P. Deshayesiana*.

11. *Pythina nuculoides*, Hanley.

Pythina nuculoides, Hanley, Proc. Zool. Soc. 1856, p. 341.

Hab. Society Islands.

This species, which is synonymous with *Erycina denticulata*, Deshayes (Proc. Zool. Soc. 1855, p. 182), is in every respect a typical *Kellia*.

* This species is referred to merely on account of its having been quoted by Hinds as belonging to *Pythina*. Four other fossil species are placed in this group by Cossmann in his Cat. illustr. Coq. foss. Eocène Envir. Paris, 1887.

12. *Pythina striatissima*, Sowerby.

Pythina striatissima, Sowerby, Proc. Zool. Soc. 1865, p. 517, pl. xxxii. fig. 7.

Hab. Borneo.

This species has only a single anterior cardinal tooth in each valve, no posterior teeth or laterals. The internal ligament is oblique and posteriorly inclined.

Its position, judging from the dentition, is certainly with *Montacuta*, and not with *Pythina* (=*Kellia*), the hinge of which is quite different. This apparently is another instance in which the general form of the shell has influenced the describer in locating it.

13. *Pythina gemmata*, Tate.

Pythina gemmata, Tate, Trans. R. Soc. S. Australia, 1878, vol. ii. p. 132, pl. v. fig. 8.

Hab. Shell-sand, Fowler's Bay, South Australia.

This species is based on two minute right valves only, about 2½ millim. in length, and it is possible they represent merely the young of some species which attains larger dimensions. It is sculptured with radiating granulous lines, somewhat like *P. striatissima*, but of course is generically distinct from that genus on account of the difference in the hinge. This is described by Tate thus:—"Right valve with a bifid cardinal tooth in front of a ligamental pit, laterals one on each side stout and elongated."

From this description it does not seem to correspond exactly with *Pythina*, but in my opinion more nearly approaches *Mylitta*; but without an examination of specimens it would be unsatisfactory to hazard a definite opinion.

14. "*Pythina setosa*, Dunker," Jeffreys.

Pythina setosa, Dunker, Jeffreys, Proc. Zool. Soc. 1881, p. 693.

Dr. Jeffreys is altogether wrong in his identification of this species, which was correctly described by Dunker as a *Coralliophaga* (*vide* Grube's 'Insel Lussin und ihre Meeresfauna,' 1864, p. 48). He states that it "belongs to *Pythina* in respect of the hinge as well as of the peculiar divaricating structure," and he gives as synonyms *Kellia Macandrewi*, Fischer, *Scintilla recondita*, Fischer, and *Sportella Caillati*, Conti. The last two I do not know; but with regard to the first, I may observe that it has not the remotest resemblance to Dunker's species. This is a true *Coralliophaga*, has no

divaricating sculpture, the form of the genus *Modiola*, and is covered with a peculiar setose epidermis. A specimen from the 'Porcupine' expedition, presented to the British Museum by Dr. Jeffreys under the name of *Pythina setosa*, appears to be the young of *Kellia Macandrewi*, Fischer, which, according to the dentition, agrees with *Montacuta*, having only a distinct anterior tooth in each valve, the posterior one, which is more evident in *Tellimya*, being obsolete.

15. "*Pythina Geoffroyi*, Payraudeau," Jeffreys.

Pythina Geoffroyi, Payr., Jeffreys, Proc. Zool. Soc. 1881, p. 694.

Hab. Mediterranean, Atlantic.

This species has no divaricate sculpture and is usually located with the typical forms of *Kellia*.

16. *Pythina Cumingii*, A. Adams.

Pythina Cumingii, A. Adams, Proc. Zool. Soc. 1856, p. 47.

Hab. Island of Bohol, Philippine Islands.

This species has almost the same dentition as *Lepton*; indeed, the difference is so slight as to be of no importance. In *Lepton* the hinge is composed of a pair of teeth-like laminæ on each side of a central excision of the hinge-plate in the right valve; in the left there is a small cardinal in front of the cartilage-pit and on each side a single lateral which fits in between the laterals in the opposite valve. In the present species the small cardinal of the left valve is wanting or consolidated with the base of the anterior lateral. Another feature in which the present species agrees with *Lepton* is the fine punctuation which occurs on both the anterior and posterior dorsal areas, a feature unnoticed by Mr. Adams in his brief diagnosis.

17. *Pythina lævis*, Carpenter.

Pythina lævis, Carpenter, Cat. Mazatlan Shells, p. 112.

Hab. Mazatlan.

An examination of this species shows that it should be placed in *Tellimya* and that its nearest ally is *T. paula*, A. Adams. Carpenter correctly observes, "The character of the hinge seems more related to *Montacuta* than to *Kellia*." The elongate, very slender, lateral teeth he mentions are of no importance.

18. "*Pythina compacta*, Gould" (Tryon).

Kellia compacta, Gould, Proc. Boston Soc. Nat. Hist. 1861, vol. viii. p. 33; Otia Conch. p. 173.

Pythina compacta, Tryon, Proc. Acad. Nat. Sci. Philad. 1872, p. 232.

Hab. —— ?

Respecting the hinge of this species Gould writes:—"Valvulæ alteræ dentibus duobus magnis, divergentibus, equalibus; alteræ marginibus dentibus simulantibus, elongatis; fossa ligamentali ampla." "Its hinge is like that of *Pythina*, Hinds. A knowledge of the animal can alone remove it definitely from the old genus *Kellia*."

From this two things are evident: firstly, that this species belongs to *Tellimya*, and, secondly, that Gould did not know *Pythina* nor the exact dentition of *Kellia*.

Tryon was probably induced to place this species in *Pythina* through Gould's statement respecting its similarity of dentition.

19. *Pythina rugifera*, Carpenter.

Pythina rugifera, Carpenter, Proc. Acad. Nat. Sci. Philad. 1865, p. 57.

Hab. Puget Sound, west coast of North America.

The hinge of this species is thus described by Carpenter:—"Dente cardinali uno minore, clavicula antica laterali inconspicua; laterali postico nullo." This description shows that the shell in question is quite distinct from *Pythina* (=*Kellia*). Without seeing a specimen it is impossible to state its true position; but temporarily I suggest its location in *Montacuta*, from the fact of there being no posterior teeth.

Conclusions.

From a perusal of the preceding observations it will be seen—

(1) That the so-called genus *Pythina* differs from *Kellia* only in having the surface ornamented with divaricating plicæ, a feature, in my judgment, only of specific value.

(2) That it is restricted to one species, namely *P. Deshayesiana* of Hinds.

(3) That the eighteen other species which have been located in *Pythina* should, *according to their conchological characters*, be thus classified:—

"*P. Deshayesii*, Récluz" (H. & A. Adams), in *Mylitta*.
P. tasmanica, Ten.-Woods . . . . . . in *Mylitta*.
P. Stowei, Hutton . . . . in *Mylitta*.
P. gemmata, Tate . . . . in *Mylitta*?
P. mactroides, Hanley . . . . in *Kellia*.
P. nuculoides, Hanley . . . . in *Kellia*.
"*P. Geoffroyi*, Payr. (Jeffreys)" . . . in *Kellia*.
P. paula, A. Adams . . . . in *Tellimya*.
P. peculiaris, A. Adams . . . . in *Tellimya*.
P. lævis, Carpenter . . . . in *Tellimya*.
P. arcuata, A. Adams . . . . in *Tellimya*.
P. triangularis, A. Adams . . . . . . in *Tellimya*.
"*P. compacta*, Gould" (Tryon) . . . . in *Tellimya*.
"*P. arcuata*, Lamk." (Hinds) . . . . . in *Tellimya*?
P. striatissima, Sowerby . . . . in *Montacuta*.
P. setosa, Jeffreys (non Dunker) . . . in *Montacuta*.
P. rugifera, Carpenter . . . . in *Montacuta*?
P. Cumingii, A. Adams . . . . in *Lepton*.

(*b*) On *Mysella*.

This genus was created by Angas for a small Australian bivalve and described in the Proc. Zool. Soc. 1877, p. 176. The description he gives of the hinge is inaccurate in more respects than one. In one valve, which I take to be the left, he mentions "a single small, diverging, subcircular, flattened cardinal tooth." This is posterior to the triangular cartilage-pit beneath the umbo. It certainly cannot be called "subcircular," for the upper side of it is almost straight and the lower gently curved. In addition to this there is a second but much smaller tooth on the anterior side of the cartilage-pit, entirely overlooked by Mr. Angas. The right valve has the hinge-margin on each side the umbo produced, forming teeth as it were, which fit in above those of the opposite valve.

I have carefully studied the types of *Mysella anomala*, Angas, and *Mysella donaciformis*, Angas, kindly presented to the British Museum by that author, and I fail to discover any reasons for separating them from the genus *Tellimya*. The fact of the cartilage-pit being more visible and more triangular than in the type of the genus, *T. bidentata*, is of no importance, and merely what we might expect in larger species like those.

(*c*) Description of a new Species of *Mylitta*.

Mylitta auriculata, sp. n. (Pl. XIII. A. figs. A, B, C.)

Testa subcircularis, æquilateralis, superne utrinque umbones auriculata, auriculis tenuibus, excurvatis, alba, mediocriter convexa; valvæ crassæ, umbones versus sublæves, deinde usque ad marginem radiatim fortiter costatæ, costis subacutis, prominentibus, inter costas concentrice rugose striatæ, vel tenuissime lamellatæ; umbones parvi, acuti, antrorsum curvati; dens cardinalis unicus valvæ dextræ parvus, conicus, laterales duo utrinque sed prope umbonem validi, divergentes; dens cardinalis valvæ sinistræ bifurcatus, lateralis unicus utrinque prominens, crassus; fossa ligamenti profunda, mediana, subtriangularis, pone dentem cardinalem sita; pagina interna radiatim sulcata, ad marginem valde crenulata, ad extremitates costarum breviter incisa; cicatrices parvæ, subrotundæ, et linea pallii simplex.

Longit. 8 millim., alt. $6\frac{1}{2}$, diam. $3\frac{1}{4}$.

Hab. Tasmania.

In solidity, colour, and dentition this very remarkable shell agrees exactly with the type of *Mylitta*, but differs from it in having the superficial costæ arranged in a radiating instead of a divaricating manner. This difference, as in the case of *Pythina* with regard to *Kellia*, I regard merely of specific importance.

The valves, when viewed inside with the umbo upward, recall the aspect of a bat, the outwardly recurved auricles representing the ears.

The three valves upon which this description is based have been presented to the British Museum by Mr. J. H. Ponsonby. He informs me that he received them from Tasmania under the name of *Pythina Deshayesii*, and therefore it seems likely that this form is wrongly recognized there as that described by Récluz.

EXPLANATION OF PLATE XIII. A.

Fig. A. *Mylitta auriculata.* Left valve, interior.
Fig. B. „ „ Right „ „
Fig. C. „ „ Left „ exterior.
Fig. D. *Mylitta Stowei.* Left valve, interior.
Fig. E. „ „ Right „ „
Fig. F. „ „ „ „ exterior.
Fig. G. *Mylitta Deshayesii.* Right valve, exterior.

XXVII.—*Descriptions of Nine new Terrestrial and Fluviatile Mollusks from South Africa.* By JAMES COSMO MELVILL, M.A., F.L.S., and JOHN H. PONSONBY, F.Z.S.

1. *Pisidium Langleyanum*, sp. n.

P. testa trigono-ovali, tumida, inæquilaterali, postice producta, antice breviter truncata, exilissime concentrico-striata; umbonibus subprominentibus obtusis, dentibus minutissimis, normalibus.

Long. $2\frac{1}{2}$, lat. 3 mill.

Hab. Port Elizabeth.

We have the advantage of the high corroborative authority of Dr. Clessin respecting the claims of this little mollusk to rank as a new form of a most obscure and difficult genus. It is perhaps the smallest of all the species.

2. *Cyclostoma transvaalense*, sp. n.

C. testa conoidea, effuso-pyramidali, fuscescente, profunde sed anguste umbilicata; spira elata; anfractibus quinque, convexis, duobus ultimis rapide accrescentibus, ad suturas canaliculatis, costis transversis regulariter spiraliter decussatis; peristomate rotundato, tenui, continuo, haud reflexo.

Long. 7, lat. 6 mill.

Hab. Pretoria.

A beautiful shell, of effuse growth, deeply but somewhat narrowly umbilicate, the sulcations on the whorls forming a close, parallel, equidistant series of grooved lines, the interstices between which are densely superficially and longitudinally lineated, channelled at the sutures; lip thin, continuous, not reflected.

3. *Helix* (*Dorcasia*) *namaquensis*, sp. n.

H. testa vix umbilicata, globulosa, superficie minutissime longitudinaliter rugoso-striata, parum nitente, fusco-gilva, tenui; anfractibus quinque, ultimo inflato, rotundato, ad labrum submalleato: columella lævi, albida; apertura ovata; peristomate reflexo, albido, margine columellari calloso, subdilatato; umbilicum obtegente.

Long. 30, lat. 27 mill.

Hab. Namaqualand (*Mr. Lightfoot*).

A distinct addition to the section *Dorcasia*, of a form which may very probably exist in collections, in company with the next (*H. porphyrostoma*), mixed up with specimens of *H. rosacea* and *globulus* (Müll.), from which it differs by the characters given above. Two specimens in coll. J. H. P.

4. *Helix* (*Dorcasia*) *porphyrostoma*, sp. n.

H. testa obtecte umbilicata, conico-pyramidali, ampla, longitudinaliter rugoso-striata, pallide cinereo-albescente, solidula; anfractibus quinque, subconvexis, ultimo rotundato; apertura ovata, intus purpurea; peristomate reflexo, purpureo, columella lævi.
Long. 43, lat. 38 mill.

Hab. Namaqualand.

This very fine species is near the well-known *H. globulus* (Müll.), from which, however, and all near allies it differs in the conically pyramidal shape, the whorls being gradually attenuate towards the apex. There is no sign of malleation, so conspicuous a feature in *H. globulus* and *rosacea* in all their forms; and, lastly, the outer lip is more simple, being not so conspicuously reflected, nor is the deposit of purple enamel both on the outer and columellar lips so rich in either substance or colour.

Two specimens, both precisely similar. There are also unnamed examples in the National Collection.

5. *Helix* (*Dorcasia*) *gypsina*, sp. n.

H. testa obtecte umbilicata, globuloso-conica, crassa, longitudinaliter rugoso-striata, calcareo-albescente, parum nitente; anfractibus quinque, anfractu ultimo compacte rotundato; apertura depresso-ovali, intus albescente; peristomate reflexo, albo, margine columellari lævi, albo.
Long. 24, lat. 20 mill.

Hab. Springbok, Africa mer.

We consider this sufficiently to differ from *H. namaquensis*, the shell being of decidedly less delicate substance, more compact, and of a chalky whiteness; the mouth less effuse and distinctly ovate-depressed at the base. It is also considerably smaller; nor is the slight malleation, so noticeable in the last whorl of that species, to be found in *H. gypsina*.

6. *Helix* (*Patula*) *viridescens*, sp. n.

H. testa profunde lato-umbilicata, tenui, planato-depressa, albescente, cornea epidermide tecta; anfractibus tribus, rapide accrescentibus, lævibus, nitentibus, ultimo magno, subeffuso; apertura lunari-ovata, obliqua; peristomate simplici, tenui.
Long. 5 mill. spec. majoris, lat. 2 mill.

Hab. Pretoria, Transvaal.

A small shell, with olivaceous epidermis and of simple character.

7. *Helix* (*Pella*) *liricostata*, sp. n.

H. testa depressiuscula, rugulosa, tenui, cornea, olivaceo-nigrescente, liris rugatis confertim irregulariter undique cincta; anfractibus quatuor, rapide accrescentibus, umbilico profundo, $\frac{1}{3}$ diametri superante; apertura lunari, peristomate simplici, recte tenui.

Long. 1·50, lat. 2·50 mill.

Hab. E. Griqualand.

An extremely interesting little species, of dark horny texture throughout, beautifully longitudinally sculptured with oblique radiating liræ. This shell is allied to *H. rivularis*, Krauss, judging from his figure; but we have not been so fortunate as to be able to examine the shell itself.

8. *Helix hottentota*, sp. n.

H. testa parva, profunde sed anguste umbilicata, globoso-depressa, olivaceo-cornea, tenui, confertim obliquis striis minutis lirata, hic illic crassioribus, quasi varicosis; anfractibus $4\frac{1}{2}$, convexulis, ultimo subeffuso; apertura lunari-ovata; peristomate tenuissimo, margine columellari reflexo.

Long. $\frac{3}{4}$, lat. $1\frac{1}{4}$ mill.

Hab. Port Elizabeth.

An extremely minute, thin, horny, subpellucid shell, olive-brown in colour, very deeply though somewhat narrowly umbilicate, very finely obliquely close-ribbed throughout (but this is barely distinguishable without a lens); the plications of the striæ are occasionally thicker, giving here and there an appearance of varices; lip simple, very thin, columellar margin slightly reflected at the umbilicus. This species cannot be confounded with any other from South Africa which has yet come under our notice.

9. *Vertigo thaumasta*, sp. n.

V. testa oblongo-cylindrica, sinistrali, ad apicem albida, gradatim olivaceo-fuscescente usque ad basin; anfractibus sex, tumido-convexis, nitidis, lævibus, ad suturas compressis; peristomate ovato-oblongo, tridentato—uno infra insertionem marginis sinistri, pliciformi, intrante, altero in medio marginis columellaris, tertio pliciformi, intrante, in margine basali.

Long. 3, lat. 1·50 mill.

Hab. Port Elizabeth.

A truly remarkable shell, and one of which the genus itself is a little doubtful until the animal be examined. It is sinistral, cylindrical, whitish at the apex, otherwise brown, the mouth being furnished with four deeply-seated plaited

teeth, placed one on the body-whorl between the two margins, one in the centre of the right, and two on the basal margin of the peristome.

Two or three specimens.

Note.—Referring to our last paper in the 'Annals' for December 1890, we regret that, by an oversight, the name *Helix Hudsoniæ*, Bens., was throughout printed *H. Huttoniæ.*

XXVIII.—*Descriptions of Two new Species of* Lycænidæ *from West Africa, in the Collection of Mr. Philip Crowley.* By Emily Mary Sharpe.

Cigaritis delagoensis, sp. n.

I have been unable to find any description which agrees with this species. I therefore venture to describe it as new. There is one specimen in the Natural-History Museum, which is also unnamed. This Museum specimen is slightly larger than the type.

Upperside. Both wings yellowish brown; hind margin with a very narrow marking of dark brown, the fringe, which is very distinct, being white. On the fore wing there is a slight indication of a small spot at the end of the discoidal cell, rather darker than the ground-colour. The wings have a shiny bronze appearance when looked at laterally.

Underside. Much paler in colour than the upperside. The fore wing is very much spotted with black and silver. In the discoidal cell are three spots, the one near the base of the wing being the smallest and black; the other two have silvery centres and are outlined by a narrow border of black. Beyond the cell are two rows of black spots, commencing below the subcostal nervure and terminating above the submedian nervure. Near the hind margin is a complete and distinct row of silver spots. The costal margin is also much spotted with silver.

Hind wing with alternate rows of darker brown and silver spots, decreasing in size towards the base.

Exp. 1 inch.

Hab. Delagoa Bay.

Zeritis bicolor, sp. n.

I have ventured to describe this species, as there are six specimens, all alike, in Mr. Crowley's collection, which has at the same time eight specimens of *Z. leonina*, E. M. Sharpe. I therefore think that there can be no doubt of the distinctness of *Z. bicolor* from *Z. leonina*.

The underside resembles that of *Z. leonina* very closely, but the upperside is decidedly different, especially as regards the fore wing.

Fore wing entirely black, with the exception of a very minute spot or streak of orange-rufous on the inner margin nearest to the hind margin.

Hind wing: base shaded with black; costa and part of hind margin broadly marked with black, which gradually decreases and terminates at the end of the second median nervule. The rest of the wing is bright orange-rufous, which fades to a pale yellow on the inner margins.

Exp. 1·2 inch.

Hab. Sierra Leone.

XXIX.—*Notes on some Scorpions collected by Mr. J. J. Walker, with Descriptions of Two new Species and a new Genus.* By R. I. Pocock.

[Plate XIII. B.]

Buthus scaber (Hempr. & Ehrb.).

Prionurus scaber, Hempr. & Ehrb., Symb. phys. Scorp. no. 13, pl. ii. fig. 7.

? *Buthus dimidiatus*, Simon, Ann. Mus. Genov. xviii. pp. 244, 245, pl. viii. fig. 17 (1882).

Mr. Walker obtained two specimens from Perim Island, at the entrance of the Red Sea. Ehrenberg's type was from Arkiko, on the coast of Abyssinia. *B. dimidiatus* was captured at Tes, in Arabia.

Mr. Walker's specimens are undoubtedly co-specific with the type of *P. scaber*, since they closely agree with Ehrenberg's admirable figure of his species.

M. Simon describes *dimidiatus* as having the tail *fere parallela* and the vesicle *subter valde et grosse tuberculata*—two phrases which certainly do not apply either to the figure of *scaber* or to my specimens of this species. In the figure

and in the specimens the vesicle is almost smooth beneath and the tail is much thicker at the base than at the apex. In other respects the description of *dimidiatus* applies closely to the examples Mr. Walker obtained.

Prof. Kraeplin, for some unknown reason, thought *scaber* might be a synonym of *gibbosus* of Brullé. In face of the figure of *scaber* this view is quite untenable; for it is clearly shown that the inferior keels of the fifth caudal segment are uniformly granular throughout—a character to which even Prof. Kraeplin appears to attach some importance, judging from the prominence he has given to it in his synoptical table of some of the species of the genus. In *gibbosus*, as is well known, these keels are irregularly dentate. But this is not the only error into which Prof. Kraeplin has fallen in his attempt to give the synonymy of *gibbosus*; for, without qualification, he adds *confucius* of Simon to the list. This is the second time that it has fallen to my lot to rescue *confucius* from oblivion; but I have now neither the time nor the inclination to point out how it differs from *gibbosus*. I will merely say that no one accustomed to handling scorpions could, with the species before him, possibly confound the two.

Prof. Kraeplin suggests, moreover, that *B. nigrocinctus* of Ehrenberg may be another synonym of *gibbosus*. To this it may be said that there is nothing in the description and the figure of *nigrocinctus* to justify this belief.

B. scaber, as Karsch long ago pointed out, belongs to the *hottentotta* group. But the time, I believe, has not yet come for asserting positively, as Prof. Kraeplin has done in the case of other species, that it is a synonym of *hottentotta*. It at least differs from all the specimens of *hottentotta* and of *Martensii* that I have examined in the absence of the median lateral keel on the third and fourth caudal segments. Of all the forms known to me it approaches nearest to *judaicus*.

Buthus quinque-striatus, Hempr. & Ehrb.

Buthus quinquestriatus, loc. cit. no. 1, pl. i. fig. 5.

Two specimens were obtained at Perim Island. The British Museum has many specimens of this species from Egypt, and others from Jerusalem, Algeria, the Cape of Good Hope, and South Africa. The specimens from the Cape and from South Africa were in the Earl of Derby's collection. If the localities are to be trusted the distribution is of very great interest, for I am not aware of a single other scorpion that occurs in both North and South Africa. Since, however, so far as I am aware, this is the only record of the extension of *B. 5-striatus* south of the equator, it seems advisable to

wait for confirmation of the fact before accepting it definitely as true.

Isometrus bituberculatus, sp. n.

Colour (in alcohol) variegated with fuscous above, pale beneath, the brachium almost entirely fuscous, fulvous only at its distal extremity; manus fulvous, dactyli fuscous in their distal half, posterior half of the fifth caudal segment fuscous, lower half of vesicle and distal half of aculeus fuscous.

Cephalothorax coarsely granular throughout, the granules showing a distinct tendency in some parts to constitute definite keels; the posterior median keels well marked, slightly diverging in front; the median eyes large, the tubercle granular at the sides.

Tergites coarsely granular, the median keel well marked; a tubercle on each side of the median keel on the posterior margin marks the position of the lateral tergal keels characteristic of, e. g., *Buthus*; the lateral keel on the seventh tergite subequal in length, with the posterior granule a little longer.

Sternites mostly smooth, the fourth and fifth granular at the sides; the fifth marked with four granular keels, the lateral of which almost attain the posterior margin.

Tail moderately strong and long, the first, second, and third segments furnished with ten strong granular keels, the fourth with eight keels and merely vestiges in front of the supernumerary median lateral keel, all the intercarinal spaces more or less granular; the posterior granule of the four superior keels on the first three segments and of the two superior keels on the fourth segment a little larger than the rest; the fifth segment with its intercarinal spaces coarsely and subserially granular, smooth and depressed in the middle line above. *Vesicle* of average form, distinctly granularly carinate beneath, the aculeus elongate and curved.

Palpi, *humerus*, and *brachium* with their keels strongly developed, granular, the intercarinal spaces finely granular; *manus* narrower than the brachium, above bearing distinctly granular keels; *dactyli* long, slender, and curved, in contact throughout their length.

Legs granular and carinate; the posterior two pairs with small tibial (tarsal) spur.

Pectines short, furnished with 11–12 teeth.

Measurements in millimetres.—Total length 16, length of tail 9, of cephalothorax 2·5, of manus and dactyli 3, of dactyli 2.

A single specimen (young) from Baudin Island.

I cannot refer this specimen to any known species of *Isometrus*. Perhaps it is most nearly related to *I. variatus* of Thorell; but it appears to me to differ from this last-named in its granularly carinate hands, its more distinctly carinate cephalothorax, and in the presence of a tubercle which marks the position of the lateral tergal keels, &c.

On p. 84 of his recent attempt to revise the Buthidæ, Prof. Kraeplin boldly gives *I. Thorellii*, Keys., as a synonym of *I. variatus*, Thor., and both as synonyms of *I. marmoreus* of C. Koch. But I think he is wrong in considering *Thorellii* as synonymous with *variatus*. The British Museum has six of Keyserling's examples of *variatus* and many specimens of *Thorellii* from Australia (Sydney, Swan River, Goulburn River), not including Keyserling's own examples from Sydney—the whole number making a total of fifteen specimens of both sexes—and these are very uniform in character, *i. e.* they are all considerably smaller than *I. variatus*, are more deeply infuscate above and always infuscate below, and the vesicle and aculeus have a different form from those of *I. variatus*. I know that Prof. Kraeplin has very little regard for variations of colour, but he has not explained the difference in the shape of the caudal vesicle between the two species. This character, correlated with the difference of size (the specimen of *Thorellii* being to all appearance adult) and the difference of colour, justify, in my opinion, the rejection of this author's view. For my own part, I feel tolerably sure that *Thorellii is* synonymous with *marmoreus*, but that *variatus* is a distinct species.

Urodacus novæ-hollandiæ, Peters.

Urodacus novæ-hollandiæ, Peters, Mon. Ak. Wiss. Berlin, 1861, p. 511; Pocock, Ann. & Mag. Nat. Hist. (6) ii. pp. 169, 170, pl. viii. fig. 1; not *U. novæ-hollandiæ*, Keyserling, Arach. Austral. pt. 32, pp. 34, 35, pl. iii. fig. A.

Mr. Walker obtained a single specimen at Fremantle, near Perth, in W. Australia—a locality new for the species.

I find upon examining the specimens that Count Keyserling described and figured as *U. novæ-hollandiæ* that they are not the same species as those specimens in the British Museum to which I had applied this name—one of which is figured in the above-mentioned number of the 'Annals.'

My reason for thinking that my identification is probably correct and that Count Keyserling was in error is that Peters described the hands of his species as being "*stark gekielt*." This expression applies to my specimens much more forcibly

than to those in Keyserling's collection; for, as may clearly be seen from the figure given by this author, the keel on the upper surface of the hand is very feebly developed.

I propose to call this species *U. Keyserlingii*, in honour of the late eminent arachnologist.

This new species is most closely allied to *U. abruptus*, Pocock, and may prove to be identical with it. The hands, however, are much less strongly keeled.

IODACUS, gen. nov.

Cephalothorax with ante-ocular portion flat and anterior margin widely excavated; *median eyes* in the middle of the cephalothorax, the tubercle cleft; *lateral eyes* two, above the border of the cephalothorax.

Sternum pentagonal, as long as wide, with sides subparallel, perhaps very slightly converging anteriorly.

Tail weak, furnished below with a single median keel, exactly as in *Urodacus*, without a spine beneath the aculeus.

Chelicerœ with lower borders of digits unarmed; apex of movable digit simple, undivided.

Chelœ with hands flat, almost as in *Euscorpius*; the proximal half of the digits furnished with many small subequal denticles, irregularly arranged in three rows; the distal end with a median series of denticles and an external and internal series formed of transversely set denticles.

This new genus is closely related to *Urodacus*, Peters, as is shown by the presence of a median keel on the lower surface of the caudal segments &c. It differs, however, in the shape of the sternum, which is as long as wide, and in having the upper surface of the manus flattened. In *Urodacus* the sternum is considerably wider than long and the hand is convex above. It is probably also related to *Ioctonus*—a genus unknown to me; but it certainly differs in the keeling of the tail and in the form of the sternum *.

Iodacus Darwinii, sp. n. (Plate XIII. B.)

Colour (in alcohol) pale ochraceous or testaceous throughout.

Cephalothorax perfectly smooth, very sparsely punctured and hairy, narrowed anteriorly, its posterior width greater

* The sternum in *Ioctonus* is presumably wider than long. In his description, however, of *I. manicatus* Dr. Thorell (p. 263) says:—"*Sternum duplo fere longius quam latius*;" whereas of the following species, *I. orthurus* (p. 265), he remarks, "*Sternum multo latius quam longius*." If these descriptions be exact the two species can scarcely be congeneric. But there can, I think, be little doubt that in the case of *I. manicatus* the words *longius* and *latius* have become transposed; for no scorpion to my knowledge has the sternum nearly twice as long as wide.

than its length, depressed laterally, the frontal lobes rounded, divided throughout by a longitudinal sulcus, which immediately behind the eye expands into a shallow triangular depression; *median eyes* small, separated by a distance greater than a diameter; anterior eye of the *lateral* pair longer than the posterior and separated from it by a space about equal to the diameter of the posterior eye.

Tergites perfectly smooth throughout and shining, sparsely and subsymmetrically punctured and hairy in front, depressed on each side of the middle line; the posterior tergite very weakly granular laterally and posteriorly. *Sternites* smooth and shining, sparsely punctured and hairy, on each side of the middle bearing two posteriorly abbreviated impressions; posterior sternite furnished with two smooth anteriorly abbreviated keels, and between them with two fine juxtaposed impressions. *Stigmata* narrow and slit-like.

Tail about three and a half times the length of the cephalothorax, slender, narrowed posteriorly, the first segment furnished with nine keels, the second, third, and fourth with seven keels, the median lateral keel on the second being represented by merely a short, anteriorly abbreviated crest in the posterior fourth of the segment, and being entirely absent on the succeeding segments; the superior keels of these four segments only very finely granular, the inferior keels smooth, intercarinal spaces smooth; fifth segment with its upper surface smooth and nearly flat, sulcate anteriorly, the superior keels very finely granular, the lateral keel also finely granular and posteriorly abbreviated, the inferior surface granular, the lateral and median keels coarsely granular, the median keel double nearly throughout its length, the space between the two halves gradually widening posteriorly. *Vesicle* narrow, pyriform, punctured and hairy, and exceedingly finely granular beneath, the aculeus short and but little curved.

Palpi powerful; humerus smooth above, below, and behind, the anterior surface coarsely but irregularly granular, the supero-posterior keel evenly granular throughout; *brachium* smooth and not costate supero-posteriorly, its posterior surface deeply marked with pores and very hairy, its inferior surface smooth below, bounded behind by a smooth ridge, in front of which is a distinct series of punctures; the anterior surface nearly flat, bounded above and below by a ridge which is exceedingly finely granular; *manus* smooth, nearly flat above, its upper surface marked mesially by an almost obsolete, posteriorly abbreviated ridge, which starts from the immovable dactylus, the posterior or external surface meeting the upper surface at an obtuse angle, strongly convex from above down-

wards, a double series of punctures above its inferior keel; lower surface furnished close to the posterior keel with a series of about twelve piliferous pores; the anterior surface smooth, its upper edge feebly granular; the upper surface when examined with a lens is seen to be adorned with a very fine reticulated pattern; *dactyli* of normal form, in contact throughout.

Legs short, coxæ smooth, femora very finely granular in front; two rows of spines on the under surface of the distal tarsal segment or foot, the claws free, covered only at the base by the lateral lobes of the foot, the second tarsal segment furnished with a single distal spur.

Pectines short, furnished with eleven similar teeth, the basal sclerite of the intermediate laminæ slightly lobate.

Genital operculum with right and left halves completely fused to form a plate which is about twice as wide as long, with rounded sides and a lightly convex posterior border.

Measurements in millimetres.—Total length 59; length of cephalothorax 7·5, greatest width 8; length of tail 27, of first segment 3·3, of second 3·8, of third 4, of fourth 4·2, of fifth 6·5, width of first 3, of end of fifth 2: palp—length of humerus 5·5, width 3; length of brachium 6·5, width 3; length of "hand-back" 7, width of hand 5·3, height of hand 3; length of movable dactylus 7·6.

A single female specimen from Port Darwin (N. Australia).

The form of the genital operculum in this species is the same as in the type of *Urodacus excellens*, Pocock *.

XXX.—*A List of the Land and Freshwater Shells of Barbados.* By EDGAR A. SMITH and Col. H. W. FEILDEN.

BARBADOS lies about one hundred miles to the eastward of all the West-Indian islands, and is separated from its nearest neighbours, the group designated the Windward Islands, by an oceanic depression of 1000 to 1500 fathoms; between Barbados and the island of Tobago to the southward, which latter has presumably been connected with the mainland of South America since the introduction of its existing fauna and flora, we find depths of over 1000 fathoms. To the eastward of Barbados the floor of the ocean rapidly sinks into the profound depths of the Atlantic. Though Barbados is not

* Ann. & Mag. Nat. Hist. (6) ii. pp. 170–172, pl. viii. fig. 2.

separated from the chain of the Lesser Antilles or the mainland of South America by any considerable expanse of ocean, yet its geological structure shows that it can lay claim to being a truly oceanic island, in the sense of its not having been connected with the continent since the introduction of its present, comparatively speaking, meagre fauna *.

A critical examination of the mammals and reptiles now inhabiting Barbados shows their comparatively recent introduction, and a review of its avifauna does not point to a different conclusion, which is confirmed by this reference to the land and freshwater Mollusca. The species obtained by one of the authors (Colonel Feilden) in Barbados during 1888–89 are marked in this list by an asterisk. We do not assert that some species may not have been overlooked by him, and in consequence retain in our list several whose claims appear to us open to question; these are specifically referred to in this paper.

Only two lists of the shells of Barbados have hitherto appeared—that by Thomas Bland in the 'Annals of the Lyceum of Natural History of New York,' 1862, vol. vii. p. 351, and that by Kobelt in the 'Jahrbücher der deutschen Malakozoologischen Gesellschaft' for 1880, p. 284, which is mainly based upon Bland's Catalogue, and contains only one additional terrestrial species, "*Hyalina incisa*," and two supposed freshwater forms, *Neritina virginia* and *N. viridis*, of which the former, however, lives in salt or brackish water, and the latter is truly marine.

In the following list altogether thirty-one species are enumerated. At present only five appear to be peculiar to Barbados, namely:—*Vitrea incisa*, *Truncatella barbadensis*, *Helicina barbadensis*, *Helicina conoidea*, and *Physa granulata*. The last three of these are included in the fauna on the grounds that the specimens were labelled "Barbados" in Cuming's collection, a collection somewhat notorious for errors of locality. Although those species in reality may have come from this island, there will always be a doubt attached to them until their presence there is confirmed.

The fauna is, as might be anticipated, very like that of the neighbouring islands. Two or three of the species are found in St. Vincents, four in Grenada, five in St. Lucia, eight in Trinidad, nine in Martinique, and ten occur in various places in the north of South America.

What proportion of these last may have migrated from the islands to the continent or *vice versâ* it is impossible to say.

* Feilden, Ibis, 1889, p. 478; id. Zoologist, 1889, p. 295; id. ibid. 1890, p. 52.

In the case of the *Streptaxis*, *Bulimus oblongus*, perhaps of all the *Bulimuli*, the *Orthalicus*, the *Planorbis*, and the *Paludestrina*, we may conjecture that they have spread northward to the islands, from the fact that those genera are more numerous in species on the mainland. On the other hand, we may suppose that the *Stenogyræ* and the *Leptinaria* have migrated southward from the islands to the continent, as the species in question, *Leptinaria lamellata*, *St. octona*, and *St. Beckiana*, appear, as far as we know at present, to be more common in the islands. This is somewhat conjectural, as our knowledge respecting the distribution of any of these species is doubtlessly very incomplete, and we do not know the relative abundance of them in the various localities where they have been found.

Bulimus oblongus and the *Orthalicus* are said to have been introduced by direct personal agency, and in all probability the presence of others is attributable to the same cause. The introduction of trees and plants from one place to another affords an easy way for the transmission of land-shells either in the egg-stage or even as adult specimens.

1. *Vitrea incisa* (Pfeiffer).

Helix incisa, Pfeiffer, Mal. Blatt. 1866, vol. xiii. p. 78; Monogr. Hel. vol. v. p. 107.

Hab. Barbados.

This species was described from Barbados from specimens obtained by Mr. Theodore Gill. It is a very depressed form, with a flattened spire, and remarkable for the *distinct* impressed lines of growth which divide the last whorl into numerous segments.

2. *Helix* (*Dentellaria*) *perplexa*, Férussac.

Helix perplexa, Férussac, Hist. nat. Moll. vol. i. p. 378, pl. lvi. A. fig. 1.

Helix granifera, Gray, Pfeiffer, Conch.-Cab. ed. 2, pl. lxii. figs. 16, 17; Reeve, Conch. Icon. pl. lii. figs. 252 *a*, *b*, pl. clxxvii. fig. 1210 (as *perplexa*).

Hab. Grenada, Trinidad?, Barbados.

This species has not been previously recorded from Barbados; but some specimens, presented to the British Museum by Sir Rawson Rawson in 1870, were said to have come from that locality.

3*. *Helix* (*Dentellaria*) *isabella*, Férussac.

Helix (*Helicogena*) *isabella*, Férussac, Prodrom. p. 36, no. 87; id. Hist. nat. Moll. pl. xlvii. figs. 2.

Helix isabella, Pfeiffer, Conch.-Cab. ed. 2, p. 76, pl. x. figs. 1, 2; Reeve, Conch. Icon. fig. 249.

"This species is spread throughout the island in gullies and cool damp places. The finest and handsomest specimens were found in Turners Hall Wood, the only piece of primæval forest left in the island. They were found in May under fallen fronds of the cabbage-palm, which kept the ground damp." (*Feilden.*)

This species is recorded by M. Drouët † from Cayenne, French Guiana, where it was collected in company with its near ally, *H. dentiens*, Férussac, by Lieutenant Charles Eyriès. The latter also occurs at Martinique, Guadeloupe, and Dominica; and it is therefore rather curious that the present form appears to extend only to this one island of the Lesser Antilles. Deshayes regarded it merely as a variety of *H. dentiens*, and at one time one of the authors held the same view, but is now of opinion that they may be conveniently separated.

4*. *Helix* (*Fruticicola*) *similaris*, Férussac.

Helix similaris, Reeve, Conch. Icon. figs. 149 *a, b*; Pfeiffer, Conch.-Cab. ed. 2, pl. lx. figs. 13–16.

"This cosmopolitan species is the commonest *Helix* in the island, and is found plentifully under stones, and also after rain crawling on the grass. It is abundant on the lowlands as well as on the high ground of Scotland district, at an elevation of 1000 feet and more." (*Feilden.*)

Tryon ‡ states that "this species inhabits the coffee-tree, and commerce has spread it all over the world, wherever coffee is cultivated." This may be the case; but, as far as we can discover, it has at present only been recorded from one of the coffee-growing West-Indian Islands, namely Cuba, where it was collected by Rang § many years ago. This, however, is doubted by Pfeiffer ||, and its occurrence there still wants confirmation. Another fact in opposition to Mr. Tryon's theory is its presence in the island of Ascension, where coffee is not grown.

It has been collected in several parts of Brazil, but apparently not further north than Bahia.

† 'Essai Moll. terrest. fluv. Guyane franç.,' par H. Drouët, 1859, p. 54.

‡ Man. Conch. ser. 2, vol. iii. p. 205.

§ Ann. Sc. Nat. (1) vol. xxiv. p. 15.

|| Conch.-Cab. ed. 2, pp. 341, 342 (*Helix*).

The coffee-tree is not generally dispersed nor the berry cultivated in Barbados; but a few plants are to be met with in the shrubberies surrounding some of the planters' houses.

5. *Helix* (*Microphysa*) *turbiniformis*, Pfeiffer.

Helix turbiniformis, Pfeiffer, Mon. Hel. vol. i. p. 49; Conch.-Cab. ed. 2, pl. xcix. figs. 31–33; Reeve, Conch. Icon. figs. 167 *a, b*.

Hab. Cuba and Jamaica.

A single specimen, marked Barbados, and identified by Pfeiffer as this species, is in the Cumingian collection.

6*. *Helix* (*Microphysa*) *vortex*, Pfeiffer.

Helix vortex, Pfeiffer, Conch.-Cab. ed. 2, no. 526, p. 110, pl. lxxxv. figs. 7–9.

Hab. Cuba, St. Croix, Haiti, Jamaica, St. Thomas, Porto Rico, Bermuda, Georgia, and Florida.

Two dead specimens are all that were obtained. The species has already been recorded from Barbados by Pfeiffer (Mon. Hel. vol. vii. p. 153), Bland, and Kobelt.

7*. *Streptaxis deformis* (Férussac).

Helix deformis, Férussac (*Helicogena*), Prodrom. p. 34, no. 42; id. Hist. Nat. Moll. pl. xxxii. *a*. fig. 1.

Hab. Venezuela, Demerara, Surinam, Trinidad.

This is the first record of the occurrence of this species at Barbados. "It occurs under stones, and though generally diffused over the island is less common than either *Helix isabella* or *H. similaris*. The living animal has a pretty appearance through the translucent shell, the foot being lemon-yellow, the tentacles red, with a stripe of the same colour down the back. The eyes, as usual, are black." (*Feilden.*)

It is common at Demerara, where it has been obtained plentifully by Mr. J. J. Quelch, of the Georgetown Museum.

8*. *Bulimus* (*Borus*) *oblongus* (Müller).

Bulimus oblongus, Reeve, Conch. Icon. fig. 210; Pfeiffer, Conch.-Cab. ed. 2, pl. xxii. figs. 1, 2.

This well-known shell has already been recorded from Barbados. "It is common in some localities, especially the gardens of plantations. It occurred in considerable numbers in the garden at Lears. In hot weather the animal half buries itself in the soil under the shade of dense-leaved trees

like the bread-fruit, only the top of the shell being visible." (*Feilden.*)

This species inhabits the neighbouring islands of St. Vincent, Tobago, and Trinidad, and it extends along the northern parts of South America from New Granada to Brazil. It is stated by Bland † that it was introduced into Barbados from St. Vincent by the Rev. J. Parkinson.

9. *Bulimulus tenuissimus*, Férussac.

Bulimus tenuissimus (Férussac), Deshayes, Hist. Nat. Moll. vol. ii. (2) p. 72, pl. cxlii. B. fig. 8; Reeve, Conch. Icon. fig. 288; Pfeiffer, Conch.-Cab. ed. 2, p. 241, pl. lxiii. figs. 25, 26.

Bulimus barbadensis, Pfeiffer, Proc. Zool. Soc. 1852, p. 61; Mon. Hel. vol. iii. p. 435.

Hab. Brazil, Cayenne, St. Vincents, &c.; Barbados (*Pfr.*).

I have compared the types of *B. barbadensis* with specimens of this species, and they appear to be inseparable. Pfeiffer's term "*solidiuscula*" is somewhat misleading, for, although one of the three specimens in Cuming's collection is a little less delicate than usual, the other two are normally thin.

10. *Bulimulus fraterculus*, Férussac.

Bulimus fraterculus, Férussac, Reeve, Conch. Icon. fig. 438; Pfeiffer, Conch.-Cab. ed. 2, p. 163, pl. xlix. figs. 5, 6.

Hab. Guadeloupe?, Porto Rico, Antigua, St. Christopher, St. Kitts, St. John, St. Croix, St. Thomas, Trinidad; Barbados (*Bland*).

This species is closely allied to *B. tenuissimus*, but is somewhat different in the proportional size of the whorls, the last being smaller than that of the species referred to.

11*. *Bulimulus exilis* (Gmelin).

Bulimus exilis, Reeve, Conch. Icon. figs. 292, 294 *a, b* (as *guadaloupensis*).

This species occurs on several of the adjacent islands and also on the mainland in Guiana. "It is very common throughout the island, under stones, and clinging to the trunks of trees, and the branches of shrubs in gardens." (*Feilden.*)

† Ann. Lyceum Nat. Hist. New York, 1862, vol. vii. p. 360.

12*. *Orthalicus zebra* (Müller).

Bulimus zebra, Reeve, Conch. Icon. pl. xv. fig. 90, pl. xxvii. fig. 90 *b*.

This species has received several names, and ranges from Mazatlan to Mexico, and Florida, through several of the West-Indian Islands, along the north part of South America into Brazil.

"It is very common in the neighbourhood of Kingstown, Jamaica, but seems confined to that area, and may be seen clinging in hundreds to the prickly-pear plants bordering the roads. I have not met with it in any other part of that island. In 1889 I brought a small basket full of them from Jamaica to Barbados; but being on arrival placed in quarantine, on Pelican Island, I turned them out there on the bushes. Subsequently I found them in limited numbers already introduced to gardens in the suburbs of Bridgetown." (*Feilden.*)

13*. *Pineria viequensis* (Pfeiffer).

Pineria viequensis, Pfeiffer, Novitat. Conch. vol. iii. p. 408, pl. xciii. figs. 39–41 (as *Macroceramus*).

This species, originally described by Pfeiffer as a *Bulimus*, has only been observed in one other island. It is curious that it has not been found between Vièque and Barbados.

"It is not generally spread over the island, but appears to be confined to the coral rocks bordering the sea, on the east side in Christchurch and St. Philip parishes." (*Feilden.*)

14*. *Stenogyra octona* (Chemnitz).

Achatina octona, Reeve, Conch. Icon. fig. 84.

The distribution of this species, like that of *Helix similaris*, is truly remarkable. It has been found in most of the West-Indian Islands, in several places along the northern parts of South America, at Costa Rica, and in the British Museum there are specimens from Central Africa, near Lake Tanganyika, and Madagascar, which appear to be inseparable.

"In Barbados it is very abundant throughout the island, and is met with in colonies under stones and rocks." (*Feilden.*)

15*. *Stenogyra subula* (Pfeiffer).

Achatina subula, Pfr., Wiegmann's Archiv f. Naturgesch. 1839, p. 352.
Bulimus subula, Reeve, Conch. Icon. pl. lxix. fig. 494; Bland, Ann. Lyc. Nat. Hist. New York, 1862, vol. vii. p. 351.

Hab. Florida, Mexico, Cuba, Porto Rico, Fernando Noronha; also Sarawak, Borneo (in Brit. Mus.).

"Found under stones in Barbados, but not common." (*Feilden.*)

16*. *Stenogyra Beckiana*, Pfeiffer.

Bulimus Beckianus, Pfr., 1846, Symb. Hist. Helic. sect. 3, p. 82; Mon. Helic. vol. ii. p. 164; Conch.-Cab. ed. 2, p. 125, pl. xxxvi. figs. 29–31.
Bulimus caraccasensis, Reeve, 1849, Conch. Icon. pl. lxviii. fig. 580.
Bulimus oryza (Deshayes, ? of Bruguière), Reeve, *l. c.* fig. 480.

Hab. Peru, Nicaragua, Caraccas, Trinidad, Brazil, Fernando Noronha.

This species was originally described by Pfeiffer as doubtfully coming from the island of Opara.

"Found under stones and rocks in Barbados, but not very common." (*Feilden.*)

17. *Stenogyra Goodalli* (Miller).

Bulimus Goodallii (Miller), Pfeiffer, Mon. Hel. vol. ii. p. 159; Reeve, Conch. Icon. pl. lxxxiv. fig. 621.

Hab. Cuba, Porto Rico, Jamaica, Guadeloupe, &c.; Barbados (*Bland*).

18. *Stenogyra octonoides*, C. B. Adams.

Bulimus octonoides, C. B. Adams, Pfeiffer, Mon. Helic. vol. iii. p. 400; Reeve, Conch. Icon. pl. lxxxiv. fig. 593.

Hab. Jamaica, St. Thomas, Cuba, Grenada, St. John; Barbados (fide *Bland*).

19. *Stenogyra Gundlachi*, Arango.

Bulimus Gundlachi, Pfeiffer, Mon. Hel. vol. vi. p. 95; Novitat. Conch. vol. iii. pl. lxxxvii. figs. 13–15.

Hab. Cuba; Barbados (fide *Bland*).

20*. *Pupa pellucida*, Pfeiffer.

Pupa pellucida, Pfeiffer, Mon. Hel. vol. ii. p. 360; Conch.-Cab. p. 89, pl. xii. figs. 24, 25.
Pupa jamaicensis, C. B. Adams, Contrib. Conch. 1849, p. 37; Pfeiffer, Mon. Hel. vol. iii. p. 558; Küster, Conch.-Cab. p. 138, pl. xvii. figs. 27, 28.

Hab. Jamaica (*C. B. Adams*); Cuba (*Mus. Cuming*).

"Found only in one spot, under stones, at Maxwell Hall, Christchurch Parish." (*Feilden.*)

It seems very probable that *P. barbadensis*, Pfr., may be the same as this species, and that the additional teeth may

either not have been noticed by Pfeiffer, or not developed in the specimens he examined. His species was described from specimens in Cuming's collection; but these we have not been able to find. There are five specimens without name or locality attached to them which may be his types, but these have the dentition of *pellucida.*

The figure of *jamaicensis* given by Küster is very good, but one of the teeth on the outer lip is omitted. Altogether there should be five—one parietal, one on the columella, and three on the outer lip.

21*. *Succinea barbadensis,* Guilding.

Succinea barbadensis, Guilding, Zool. Journ. vol. iii. p. 532, pl. xxvii. figs. 4–6.
Succinea bermudensis, Pfeiffer, Mon. Hel. vol. iv. p. 817.

Hab. "Very common under stones in pits and indentations of the coral rock, also on the top of the hills of Scotland district, crawling on the grass after a shower of rain." (*Feilden.*)

S. bermudensis is the same as this species.

22*. *Leptinaria lamellata* (Pot. & Mich.).

Achatina lamellata, Pot. & Mich. Gall. Moll. i. p. 128, pl. xi. figs. 7, 8.
Pupa lamellata, Küster, Conch.-Cab. p. 147, pl. xviii. figs. 1, 2.

Hab. Porto Rico, Guadeloupe, St. Vincents, Trinidad, Venezuela, Demerara, Guayaquil, Peru.

"Very uncommon. I have met with only four examples, all under a stone at Lears plantation, in St. Michael's Parish." (*Feilden.*)

23*. *Cylindrella* (*Gongylostoma*) *costata,* Guilding.

Cylindrella costata, Pfeiffer, Philippi's Abbild. vol. i. p. 183, pl. i. fig. 16, vol. ii. p. 52, pl. ii. fig. 8; id. Conch.-Cab. pl. v. figs. 4–6; H. & A. Adams, Gen. Moll. pl. lxxvi. fig. 7; Sowerby, Conch. Icon. vol. xx. pl. xii. fig. 109.

This species is also common in St. Lucia "upon damp walls and among stones in shady places" (*Tate*). "In Barbados it is very abundant under stones, particularly in the lowlands" (*Feilden*). There are specimens in the British Museum from St. Vincents.

24*. *Truncatella barbadensis,* Pfeiffer.

Truncatella barbadensis, Pfeiffer, Proc. Zool. Soc. 1856, p. 337; Monogr. Auricul. p. 192.

"Found on the coralline-limestone cliffs at Bathsheba and The Crane, on the Windward side of the island." (*Feilden.*)

This species is allied to, but not quite the same as, *T. bilabiata*, Pfr., from Cuba.

25*. *Helicina substriata*, Gray.

Helicina substriata, Gray, Zool. Journ. vol. i. pp. 66 and 251, pl. vi. fig. 4; Sowerby, Thesaur. vol. i. p. 14, pl. i. fig. 22, vol. iii. p. 287, pl. cclxxiv. figs. 331, 332; Pfeiffer, Conch.-Cab. ed. 2, p. 69, pl. ix. fig. 30; Sowerby, Conch. Icon. vol. xix. pl. xi. figs. 94 *a*, *b*.

Hab. St. Kitts and St. Vincents.

"This species is very common, found from the shore-line to the tops of the hills in Scotland district." (*Feilden.*)

26. *Helicina barbadensis*, Pfeiffer.

Helicina barbadensis, Pfeiffer, Proc. Zool. Soc. 1853, p. 60; Monogr. Pneumon. vol. ii. p. 218.

Hab. Barbados (in coll. Cuming).

27. *Helicina conoidea*, Pfeiffer.

Helicina conoidea, Pfeiffer, Proc. Zool. Soc. 1853, p. 53; Monogr. Pneumon. vol. ii. p. 211; Sowerby, Thesaurus, vol. iii. pl. cclxx. figs. 168, 169.

Hab. Barbados (in coll. Cuming).

In Sowerby's figures the spire is represented a little too elevated and acuminate. The figures in the 'Conchologia Iconica' (figs. 49 *a*, *b*), as pointed out by Bland (Journ. de Conch. 1875, p. 247), are altogether incorrect.

28*. *Physa rivalis*, Maton & Rackett.

Bulla rivalis, Maton and Rackett, Trans. Linn. Soc. 1807, vol. viii. p. 126, pl. iv. fig. 2.

Limnea (*Physa*) *rivalis*, Sowerby, Genera Shells, pl. clxxix. fig. 9.

Hab. Brazil, Cuba, St. Vincents, Trinidad, &c.

This species is said by Jeffreys and others to be the same as *Sowerbyana* of d'Orbigny. This is probably the case, and *P. acuminata*, Gray, is also identical.

P. rivalis of the 'Conchologia Iconica' (fig. 31) is not this species, and is at once separated by the reddish thickening within the margin of the outer lip, which does not exist in the true *P. rivalis*.

29. *Physa granulata*, Shuttleworth.

Physa granulata, Shuttleworth, Sowerby, Conch. Icon. vol. xix. pl. v. figs. 39 *a*, *b*.

Hab. Barbados (in coll. Cuming).

The close spiral striation of this species, being crossed by the lines of growth, has a minutely subgranular appearance. It is not apparent to the naked eye, but is distinctly visible under a simple lens.

30*. *Planorbis lucidus*, Pfeiffer.

Planorbis lucidus, Pfeiffer, Wiegmann's Archiv f. Naturgesch. 1839, vol. v. p. 534; Sowerby, Conch. Icon. fig. 53? (enlarged); Clessin, Conch.-Cab. ed. 2, p. 193, pl. xxix. fig. 2.

Hab. Cuba, Porto Rico, Guadeloupe, Martinique.

A single half-grown specimen is all that was obtained at Barbados.

31*. *Paludestrina crystallina*, Pfeiffer.

Paludina crystallina, Pfeiffer, Wiegmann's Archiv f. Naturgesch. 1840, p. 253; Philippi, Abbild. vol. i. p. 118, pl. i. fig. 18 (fig. 17, var. *coronata*); Küster, Conch.-Cab. p. 50, pl. x. figs. 7, 8 (figs. 9, 10, 11, 12, var. *coronata*).

Hab. Cuba, Jamaica, &c.

Both forms of this species, that with smooth whorls and that with short spines, occur at Barbados. "It was met with in Græme Hall Swamp, and was very difficult to find. They laid an immense number of eggs when captured." (*Feilden.*)

BIBLIOGRAPHICAL NOTICE.

Handbook of the London Geological Field-Class. Small 8vo, 215 pages, with 18 woodcuts. George Philip and Son. 1891. London.

This interesting little book consists of Lectures on the Geology of the London district, by Professor H. G. Seeley, F.R.S., and Reports by Students of the excursions made, from the year 1886 to 1889, to examine practically the Physical Geology of the rocks discussed in the Lectures. The plan of this Field-class Society and its Director (Chairman) is "to teach the elements of Physical Geography and Geology direct from Nature without preliminary study from books;" and, whilst taking their out-door recreation, the Students are thus training their "powers of observation, imagination, and reasoning." Local scenery and all the features of the surface are by these means not only directly noticed, but their relations to the geological structure of the country are learnt, and the causes and history of that structure are brought under notice.

Thus the variations of colour and of light and shade, the different aspects of hill and dale, the presence of particular plants and animals, with other phenomena of nature, become of especial interest for both observation and philosophical consideration.

The constitution of the Society, its Executive Committee, the plan of summer excursions and of winter lectures are explained. The Field-class includes three graduating divisions—one studying geography in relation to geology, another sections of the strata, and the third especially studies one geological formation, all in the Home Counties. The winter lectures successively treat of the geology of different parts of the South-east of England. The method, apparatus, and appliances of geological research are also indicated.

Reports of the lectures given by Prof. H. G. Seeley are then supplied: thus:—1. Introduction to Field Geography, with illustrative notes on the Chalk Hills of Kent and the Valley of the Darent; the Chalk Hills of Surrey; the Chalk Escarpment; and the Sand Hills of Frant. 2. Introduction to Field Geology. 3. The Thames Valley. 4. The Lower Greensand and Upper Neocomian, with nineteen Reports by Students on local exposures and sections of the several beds. 5. The Gault and Upper Greensand, with six local sections by Students. 6. The Chalk, with eighteen illustrative sections by the Students. 7. The Thanet Sands, with four such sections. 8. The Woolwich-and-Reading Beds, with seven such sections. 9. The London Clay, with three such sections. 10. The Brick-earth and Gravels, with four such sections. Several chemical analyses of Lower Greensand, Gault, and Chalk are included in the Reports. A tabulated Register of the fossils found by the Members during the season of 1890, drawn up by Mr. R. H. Bentley, the Secretary, is appended, with proportional blank paper for future use. The woodcuts of sections have been drawn by Mr. Nicol Brown, F.G.S., Vice-Chairman of the Society, chiefly from his own note-book; he has supplied several of the Reports, and he has edited this useful Handbook, illustrative of the Geology of a considerable portion of South-eastern England.

A striking feature in this geological book is the clearness of many of the detailed sections, as described by individual observers—often the same section noted by two or three—mentioning what is most interesting to themselves; some are Female Students. Therefore, taken as a whole, the interpretation of the sections are fitted to different minds, and are not given in one set form of thought and phrases. The influence of the Director's acute observation and broad philosophy is recognizable throughout the work.

A liberal and very useful Index, by Mr. J. H. Hodd, supplies a ready access to the manifold subjects of this Handbook, which will be welcomed by many who seek for information and find interest among the natural sources of amusement and recreation round about London.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

March 25, 1891.—Dr. A. Geikie, F.R.S., President, in the Chair.

The following communication was read:—

"Notes on Nautili and Ammonites." By S. S. Buckman, Esq., F.G.S.

1. *The Position of the Last Septum.*—Mr. Bather's theory of shell-growth in Cephalopoda (Ann. & Mag. Nat. Hist. 1888, i. p. 300) seems to depend upon the idea that the last septum in the young in *Nautilus* and *Ammonites* was always formed at a proportionately increased distance from the penultimate. This supposition is not borne out by specimens of *Nautilus*, *Witchellia*, *Lioceras*, *Ludwigia*, and *Grammoceras* examined by the Author.

2. *Shell-muscles of Nautili and Ammonites.*—Two specimens of Ammonites in the Author's collection are marked by impressions which seem to indicate the position of the shell-muscle.

May 27, 1891.—Dr. A. Geikie, F.R.S., President, in the Chair.

The following communication was read:—

"On the Lower Jaws of *Procoptodon*." By R. Lydekker, Esq., B.A., F.G.S.

After reviewing Sir R. Owen's writings upon the large extinct Kangaroos for which he established the genus *Procoptodon* in 1874, the Author describes two mandibular rami from the clay beds of Miall Creek in the neighbourhood of Bingera, N.S.W., which belong to this genus, and from their characters and a comparison of them with the lower jaws in the British Museum, he maintains that this part of the skull indicates two very distinct species of the genus, for which he retains the names *P. rapha*, Ow., and *P. goliah*, Ow., though it is possible that the types of those two species are really specifically identical, in which case the name *P. pusio*, Ow., might have to be adopted for one of the species described.

MISCELLANEOUS.

On a Freshwater Medusa. By Dr. J. v. Kennel.

In my 'Biologischen und faunistischen Notizen aus Trinidad' I alluded to a little Medusa which I had found in considerable numbers on the east coast of the island in a small freshwater lagoon entirely cut off from the sea. The creatures were altogether absent in the broader portion of the lake near the sea, and were first encountered about fifty paces further inland, where a gentle current was perceptible, and the flora as well as the fauna bore the impress of a freshwater habitat. It is true that Polychæte Annelids and specimens of *Mysis* were also found in abundance at this spot among the luxuriant Algæ and freshwater plants, yet the representatives of the small freshwater animals greatly exceeded them in

numbers: larvæ of frogs and insects, species of Daphnids, Naids, *Chætogaster*, *Dero*, *Æolosoma*, *Clepsine*, *Planorbis*, *Physa*, and *Ancylus* were so richly represented in individuals that the spectator might easily declare the water to be fresh without even testing it. The tongue was in fact the only test applied; but it was universally agreed that no saltness was perceptible to the taste. Our horses, too, drank the water unhesitatingly, without being especially thirsty, and horses are there considered to be particularly discriminating in the matter of water. On these grounds I believed that I was entitled to claim my jellyfish as a freshwater animal, and am still of this opinion, the more so since several examples of Medusæ have already been discovered in fresh water—*Limnocodium* in the *Victoria-regia* ponds in Kew Gardens and a Medusa from the Tanganyika Nyanza.

If I now attempt to describe the freshwater Medusa from Trinidad, and to assign it to its proper systematic position, this is unfortunately only possible for the sexual form, the free-swimming jellyfish, since I did not succeed in discovering a hydroid at the same spot from which it might have sprung. Apart from the possibility that I did not make a sufficiently exhaustive search, it would also be conceivable that the hydroid generation had died down at that season of the year (March), a not impossible event in the case of a tender organism proceeding from the sea, considering the high temperature of the water at that period and that at another season of the year the hydroid form would appear again; or we may suppose that the hydroids live in the sea, and that their Medusæ alone pass into the lagoon at the rainy season, when there is a communication with the ocean, and adapt themselves, at least partially, to a freshwater existence. It must be confessed that the probability of the latter theory is but small; for in none of the Medusæ which I collected were the sexual products perfectly ripe, so that we may assume that they had not very long separated from their place of origin. Communication between the water in which they were living and the sea had at that time been severed for at least two months. If they had been cut off from the sea as Medusæ this interval would well have sufficed for the attainment of full sexual maturity.

It is, however, always a serious matter to assign a species to its place in a system on the basis of one developmental stage only, when that system is to a large extent constructed on the morphological and structural relationships of the asexual generation and on the mode of development of the sexual form. Nevertheless it appears desirable so to characterize the animal that later investigators who may happen to take up the study may be able to recognize it and determine its position and affinities to better purpose.

The diameter of the bell of the little craspedote Medusa is from 2 to $2\frac{1}{2}$ millim., and in shape it is strongly arched, so that even when expanded to its utmost extent it is still almost hemispherical, and considerably more than hemispherical when in a state of contraction. The muscular ring at the margin of the bell is powerfully developed and is capable of contracting so strongly that the aperture of the velum becomes almost closed. The velum itself is thin

but very broad; it projects horizontally all round to the extent of one third the diameter of the bell. The margin of the bell is smooth and slightly undulating only when contracted more strongly than usual. Round its periphery gently bulbous swellings mark the origin of sixteen to eighteen tentacles (the number varies perhaps between wider limits), which are of great length and fineness and sharply pointed at the tips. In the specimens killed in weak osmic acid and excellently preserved they still measure from 6 to 10 millim. The nematocysts are distributed in fine closely-packed whorls throughout the entire length, with the exception of the bulbous base. On the ex-umbrellar surface of the base of each tentacle there is found an ocellum, a simple spot of pigment, without refractile body. Nevertheless several pigment-cells take part in its composition. In many tentacles the pigment-spot is circular; yet in its clear centre no stronger refractile body could be detected; we merely find a few ordinary epithelial cells surrounded by blackish-brown pigmented cells arranged in the shape of a cross. The ocelli are entirely naked; other sense-organs, as well as marginal bulbs between the tentacles, are completely wanting.

The very powerful manubrium, hanging down in the subumbrella and extensible as far as the velum, is shaped like a quadrilateral prism, with four interradial longitudinal grooves, so that a transverse section is cruciform, with the arms of the cross bluntly rounded. In accordance with this, its lumen is also cruciform, the arms of the cross having a radial direction and running into the longitudinal ridges of the manubrium.

Oral lobes are wanting. The four radial longitudinal ridges of the manubrium converge at the end with bluntly rounded tips, and so embrace the oral opening.

There is a small roundish atrium, prolonged into four radial canals, which, however, do not follow the most direct route to the circumferential canal, but are much coiled, even in the case of the living animal when perfectly at rest.

If the living animal be examined or slightly magnified it at first appears as though four broad, twisted, enteric pouches arise from the centre of the transparent bell, being distinguished by their yellowish-brown hue, and do not reach the margin of the umbrella. Sections show us that the radial canals, as soon as they leave the atrium, are indeed greatly dilated, so that their ventral wall is seen like a protuberance projecting towards the subumbrella, but that, in addition to this, they are also surrounded on both sides and on the subumbrellar surface by the gonads. These extend from the origin of the canals at the atrium along two thirds of their course, after which the canals become very fine and transparent, and proceed in true radial direction to the circumferential canal, into which they open. It is highly probable therefore that it is only in consequence of the powerful development of the gonads in the course of the originally straight radial canals that the latter acquire their twisted form through vigorous growth in a longitudinal direction.

The sexual products are, as has been mentioned above, not yet perfectly ripe in the specimens which were microscopically examined, yet I found in them a multitude of young ova already of tolerably

large size. The coiling of the radial canals is evidently insufficient for the unfolding of the gonads; the latter therefore themselves become closely twisted once more, and thereby acquire their striking breadth on the subumbrellar surface and on the sides of the canals.

The living Medusæ were of hyaline transparency, with a pale yellowish tinge; only the tentacles and the margin of the bell appeared slightly milky, the former owing to the innumerable nematocysts, the latter in consequence of the tracts of the circumferential muscle. The yellowish-brown bands of the gonads showed plainly through the tissues.

If we now consider the systematic position of our Medusa, it may be most advisable to test the diagnoses of Häckel's exhaustively worked-out system, with reference to their applicability to this freshwater form.

Häckel divides the Craspedota into Anthomedusæ, Leptomedusæ, Trachomedusæ, and Narcomedusæ. The two latter divisions do not here concern us. Neither is it necessary to consider the Anthomedusæ, for only in the Leptomedusæ do the gonads lie in the walls of the radial canals.

Of the four subdivisions of the Leptomedusæ it can only be a question of the Thaumantidæ or Æquoridæ, for in the case of the Cannotidæ the gonads are plumose branches of the radial canals, while in the Eucopidæ they are vesicle-shaped evaginations therefrom.

While, however, the Æquoridæ further "always possess marginal vesicles," which are wanting in our Medusa, there only remain the Thaumantidæ, in which the gonads form frill-like folded bands along the radial canals, marginal vesicles are always absent, ocelli usually present.

If we construct a synoptical survey of the genera which belong to this subdivision, we get the following table :—

4 radial canals and 4 gonads. *b.*
8 radial canals and 8 gonads (Melicertidæ).
16 radial canals (Orchistomidæ).
  b. 4 or 2 tentacles.
    8 tentacles.
    16 or more tentacles. *c.*
      c. No marginal bulbs nor cirrhi. *d.*
        Between the tentacles, bulbs and cirrhi.
          d. Independent mouth and atrium, no gastro-genital cross.—*Thaumantias.*
            Mouth and atrium obliterated, a gastro-genital cross.—*Staurostoma.*

According to this table we should arrive at the genus *Thaumantias* for our Medusa. The four species placed here by Häckel, however, have frilled and very variable oral lobes, which does not agree with what we find in this freshwater form.

It follows, therefore, that if we are to find a place for the medusoid form only, as I am compelled to do, a new genus must be intercalated. If, when the hydroid is discovered and the mode of development understood, a new position should be found for the creature, it can be transferred at any time to its proper place. In

the meantime my only concern was to introduce this undoubtedly interesting little freshwater Medusa into literature, under a designation and description which would enable it to be re-identified, and so I must search out for it among its companions the best possible position according to the knowledge of it which we at present possess.

Leptomedusæ.

Thaumantidæ.

Gen. nov. *Halmomises* (from ἅλμη, saltwater, and μισεῖν, to hate).

Sp. nov. *lacustris*.

Without marginal bulbs, cirrhi, or marginal vesicles. Umbrella hemispherical, 16–18 (? 24) tentacles, with gentle bulbous thickened bases, on the outer side of each of which an ocellum (simple ring of pigment). Velum thin, but broad; manubrium powerful, with broad base, bluntly quadrangular; mouth without lobes, cruciform, the four clefts in the direction of the angles. Atrium small, but distinct. Four radial canals, greatly widened in the central three fourths of their length, projecting towards the sub-umbrella; beset at this point with frill-like gonads, owing to the development of which they become coiled. The last peripheral third of the radial canals narrow, running straight.

Size, 2–2½ millim., diameter of the bell. Colour hyaline, faintly yellowish. Gonads yellowish brown.

Locality: freshwater lagoon on the east coast of Trinidad, south of Mayaro Point, in a cocoa-nut plantation.—*Sitzungsberichte der Naturforscher-Gesellschaft bei der Universität Dorpat*, Bd. ix. Heft 2, 1891, pp. 282–288.

On the Causes affecting Variations in Linaria vulgaris. By Thomas Meehan.

Few subjects more deserve the attention of thoughtful students of biology than the extent of variation aside from the conditions of environment. Instructive papers bearing on evolution are continually appearing, the full value of which is impaired by the passing suspicion that the authors have not fully perceived how great is the innate power to vary, independent of any external influences. That environment or surrounding circumstances have considerable influence on the production of new forms may surely be admitted without detriment to a profound belief that very much more is due to a tendency to change implanted in the organism, the laws governing which the keenest scrutiny has hitherto been baffled in the effort to detect. It is possibly from this confession of ignorance that the advocates of change by environment have gained so much strength. He who has something tangible to please us has more power than he who has to confess that he does not know. Those of us who would not have conceded as much to environment as is frequently claimed for it, can only insist that change is evidently going on in order, and evidently in accordance with a regular plan; while if all claimed for environment were conceded to be sound, it would subject change to the mere chapter of accidents, and the harmony and the exact dependence of one thing on another, which everywhere prevails, could scarcely exist.

It has been my fortune to have to show that in many cases where variations have been charged to crossing by foreign pollen or by other "conditions of environment," it was extremely probable that the sole actor in the work was this unknown law of change; while I have shown in many monotypic species, or in species removed from all possibility of intercrossing with other species, that the variations are quite as wide as if there had been full opportunity for the supposed laws of environment to operate.

Here I will call attention to the interesting variations any one may find in an hour's walk among *Linaria vulgaris*, the common yellow toad-flax, in any district where the conditions are absolutely identical and the plant tolerably abundant. Let one gather in the walk any specimen that seems to be slightly different from another, and he will be amazed on comparing the handful to note how great the difference. The foliage does not vary much, but some of the most divergent flowers might pardonably be referred to distinct species, did not the intermediate forms show that they were all of one family. There are variations in colour and in form. In colour some are pale straw and others deep yellow, while the palate varies from deep orange to the faintest possible tinge of yellow. At times nearly all the corolla, except the palate, is white instead of the normal tint, and again are forms in which only the backs of the two upper segments are white. But the most interesting variations are in the form of the lower lip. This is trilobed. Sometimes the lateral lobes are so broad as to overlap each other, when the central lobe seems hardly noticeable. At other times they are so widely separated that the trilobed character is noticed at a glance. In some instances the central lobe is scarcely produced, in others it is large and broad, extending to the line of the lateral lobes.

What has environment had to do with these widely variant forms? The most diverse will often be found in proximity where no one could suggest any difference whatever in the surrounding conditions. It is an introduction from Europe, and has no close allies that any one could name as likely to influence its pollination. Indeed, if these were present, they would be inoperative, as the plant is here, and probably everywhere, a close breeder, as I noted years ago. The pollen-sacs burst before the corolla opens, scattering the fertilizing dust over its stigma, which is evidently influenced thereby before the wind or insects have had any chance to operate. The flowers can gain no advantage from any outside agency, usual with those where insects have some opportunity to bring in foreign pollen before it is too late.

Aside from all this is the fact that the plants in any one given locality but a few years ago sprang from possibly one, or at most a few progenitors, which, introduced by accident from Europe, escaped the cultivator's destructive hoe, and then spread, through its progeny.

There seems no escape from the deduction that the plant derives from some pre-natal influence power to vary greatly, without any regard to the long periods of time sometimes called for, and wholly independent of external influences.—*Proc. Acad. Nat. Sci. Philad.*, May 26, 1891, p. 269.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 46. OCTOBER 1891.

XXXI.—*Note on a New and Primitive Type of Compound Ascidian.* By WALTER GARSTANG, M.A., Berkeley Fellow of the Owens College, Manchester.

DURING some dredging-operations in the neighbourhood of Plymouth, which I have recently been enabled to carry on by means of a Government grant given me by the Royal Society Committee, I met with specimens of a new and interesting Compound Ascidian, which forms the subject of the present note.

The specimens of this Ascidian were found in moderately shallow water (5 to 15 fathoms) attached to stones and shells, upon which they formed small inconspicuous incrusting colonies, freely coated with sand-grains. The colonies possess a thin, spreading, carpet-like base of test-substance, traversed by stolonial tubes, from which zooids spring up at irregular intervals. Sometimes the zooids are entirely free, but usually they are united into small clumps consisting of several individuals, the tests of which are partially fused together. The zooids project from the basal carpet of test to a variable extent: their height, as a rule, is between 6 and 10 millim. They possess a dilated and somewhat globular thoracic region and an elongated semicylindrical abdominal region, which is always more slender than the thoracic portion. The zooids bear two distinct apertures, the oral and cloacal openings, of which the former is the larger. Each aperture is bounded

by six well-marked lobes of triangular or semicircular shape. In the larger groups of zooids there is a distinct tendency to an arrangement of the individuals in such a way that the cloacal apertures are situated towards the centre of each clump, the oral apertures towards the periphery.

The test for the most part is covered with sand-grains, whereby the colonies are rendered highly inconspicuous. The adhesion of sand-grains is of interest in considering the process by which the clumps are formed. In the majority of the clumps examined, the sand-grains form a complete sheath around each zooid; they not only adhere to the test of the zooids upon their external faces, but they also separate the individual zooids of a clump from one another. The existence of foreign particles between the zooids of the clumps shows clearly that these have been formed by a process of fusion or concrescence.

In general structure the ascidiozooids agree with those of the majority of the Distomidæ. The body, when removed from the test, is seen to be divided into two regions, the thorax and abdomen, which are connected by a slender œsophageal stalk. A mature zooid is from 3 to 4 millim. in length. The musculature is well developed. In the thoracic region it consists of both longitudinal and transverse fibres united into bundles that form a strong square-meshed latticework; the longitudinal bundles appear to be arranged in six main groups, corresponding to the number of the oral lobes. In the œsophageal and abdominal regions longitudinal bundles are present, but transverse muscles are altogether absent. The ganglion is large and spherical, and the subneural gland is well developed. The buccal tentacles are about thirty in number. The pharynx possesses three rows of straight and elongated stigmata, and two moderately broad horizontal membranes with perfectly straight edges.

In young zooids I have been unable to discover any trace of oviduct or vas deferens; but in mature zooids both are present. The ova are large, and undergo their development in the atrial cavity. There is no special oviducal or cloacal diverticulum for their reception.

The characters of this Ascidian necessitate the definition of a new genus and species of the family Distomidæ:—

Archidistoma, gen. nov.

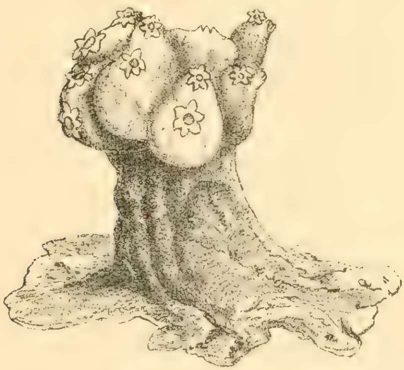
Colonies incrusting; consisting of a spreading basal portion from which arise zooids at irregular intervals. Zooids either entirely free or partially fused together to form clump-like aggregations. Oral and cloacal apertures distinct, six-lobed.

Musculature in the thoracic region consisting of both longitudinal and transverse bundles. Oviduct and vas deferens present in mature zooids. No incubatory diverticulum of the cloaca.

Fig. 1.

Archidistoma aggregatum.—A small colony, enlarged.

Fig. 2.



Archidistoma aggregatum.—Part of another colony, enlarged, showing the partial freedom of the zooids of a clump, and the tendency of the cloacal openings towards a central position.

Archidistoma aggregatum, sp. nov.

Clumps composed of a small but variable number of zooids. Test arenaceous. Tentacles about thirty in number. Pharynx possessing three rows of straight elongated stigmata; horizontal membranes between the rows of stigmata; no intermediate supporting membranes. Ova large, containing much food-yolk.

Archidistoma aggregatum is a connecting-link between the true Distomidæ (*Distoma*, *Cystodites*, *Distaplia*, *Oxycorynia*,

Colella) and the Clavelinidæ (s. str.). Hitherto no true* Distomid has been known to possess free zooids—that is, zooids not completely imbedded in a common test. This new Ascidian, however, combines the structural characters of the Distomidæ with a social form of colony which is only slightly removed from that of the Clavelinidæ.

Further, *Archidistoma aggregatum* is of especial interest because it exhibits the first stage in the evolution of the cœnobitic type of colony from the social Ascidian type, in which the zooids are entirely free and irregularly placed: in *Archidistoma aggregatum*, the clumps of zooids (primitive cœnobia) have no common cloaca, but the cloacas of the individuals are usually situated towards the centres of the groups. The second stage is exhibited in such a Compound Ascidian as *Synoicum turgens* or *Circinalium concrescens*, in which each of the isolated clumps of zooids possesses a common central cloaca.

XXXII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91. By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. Alcock, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Continued from p. 138.]

Class **ASCIDIACEA.**

Family **Cynthiidæ.**

Culeolus, Herdman.

1. *Culeolus* sp. prox. *recumbens*, Herdman.

Eight specimens of varying sizes from Station 110, 1997 fathoms, come very close to this species from the higher latitudes of the Southern Ocean, if they are not identical with it.

These are the only specimens of Tunicata that we have as yet obtained from the deep sea.

* The position of *Chondrostachys* is uncertain, but its nearest affinity seems to be with *Stereoclavella* rather than with *Oxycorynia*. *Diazona* is separated from the Distomidæ by the presence of internal longitudinal bars in its branchial sac.

Phylum **APPENDICULATA.**

Branch ARTHROPODA.

Class **CRUSTACEA.**

By J. WOOD-MASON.

Grade *MALACOSTRACA.*

Order SCHIZOPODA.

Family **Lophogastridæ.**

GNATHOPHAUSIA, Willem.-Suhm.

1. *Gnathophausia bengalensis*, sp. n.

♀. Closely allied to *G. calcarata*, Sars, from which it differs in the following points:—The carapace covers the whole of the first and a part of the second abdominal somite; the antennal, branchiostegal, and postero-inferior spines appear quite smooth to the naked eye, being only obsoletely or microscopically serrated, the supraorbital spine is readily distinguishable by its shape from the rostral denticles; the upper lateral keels are strongly roof-shaped, and the oblique subdorsal keels more pronounced; the antennal scale is more broadly emarginate at the apex; the pleural lappets of the last abdominal somite are terminated by two very unequal spines (of which the outer is long and sharp and the inner short and blunt), and are separated from one another posteriorly in the mid-ventral line by a long and narrow incision.

Length, from end of rostrum (extreme tip wanting) to apex of telson, 91 millim.; of carapace, from supraorbital to end of dorsal spine, 37 millim.; of abdomen 46·5 millim.; of telson 17·5 millim.

Colour in life deep purple-lake.

A single female, with just-commencing brood-pouch, was taken at Station 117, 1748 fathoms.

2. *Gnathophausia brevispinis*, sp. n.

Gnathophausia gracilis, var. *brevispinis*, W.-M., Ann. & Mag. Nat. Hist. (6) vii, 1891, p. 188, ♂.

♂ ♀. Differs from the Atlantic *G. gracilis*, Suhm, in the rostrum being recurved and shorter than the carapace; in the dorsal crest of the carapace being distinctly foliaceous throughout, and at the base of the rostrum expanded into a subtrian-

gular plate, terminating apically in a strongish forwardly-inclined spine; in the dorsal spine being shorter and more recurved; in the lower of the two postero-lateral spines being reduced to a minute point; in the dorsal spines of the first abdominal somite being subequal, those of the second separated by a distinct transverse groove and the hinder of them more deflexed, and those of the third, fourth, and fifth larger and more distinctly arched anteriorly; in the form of the pleura of the five basal somites, which are expanded at their posterior margin into a thin and rounded foliaceous lobe, having their marginal spines as a consequence closer together.

A single immature female (the last pair of incubatory lamellæ only 3 millim. long), measuring 92 millim. from end of rostrum (extreme tip wanting) to apex of telson, and coloured in life deep purple-lake, was taken at Station 117, 1748 fathoms.

Family **Eucopiidæ.**

Eucopia, Dana, G. O. Sars.

3. *Eucopia australis*, Dana, Sars.

Eucopia australis, Dana, U. S. Explor. Exped., Crustacea, pt. i. p. 609, Atlas, pl. xi. fig. 11, *a–m*; G. O. Sars, 'Challenger' Schizopoda, 1885, p. 55, pls. ix. and x.

Chalaraspis unguiculata, Willemoes-Suhm, Trans. Linn. Soc. Lond., Zool. ser. 2, vol. i. 1875, p. 37, pl. viii.

A soft and somewhat distorted young female with very incompletely developed brood-pouch, non-pigmented eyes, and eye-peduncles, through the walls of which the subjacent ophthalmic tract is plainly visible by transparence, as in Sars's figure, was obtained at Station 112, 561 fathoms; and a mature, or all but mature, female with integuments of firmer consistence, red-pigmented eyes, and opaque eye-peduncles, at Station 109, 738 fathoms. But whether we have here to do with two distinct species, or only with two different conditions of one and the same species, the material at our disposal is insufficient to enable me to determine.

Family **Euphausiidæ.**

Thysanopoda, H. M.-Edw.

4. *Thysanopoda microphthalma*, G. O. Sars.

Thysanopoda microphthalma, G. O. Sars, 'Challenger' Schizopoda, 1885, p. 116, woodcut, fig. 3, ♀.

An adult male, without legs, from Station 111, 1644 fathoms, is probably referable to this species.

Order DECAPODA.

Suborder NATANTIA.

PENÆIDEA.

Family **Penæidæ**.

Subfamily *Penæina.*

No representatives of this group have as yet been found amongst either the infra-littoral or the bathybial fauna.

Subfamily *Parapenæina.*

Obs. Spence Bate's *Artemisia longinaris* belongs here; it is not in the remotest degree related to the Aristæina.

Metapenæus, gen. nov.

Allied to *Parapenæus*, S. I. Smith, differing therefrom in having neither tergo-pleural nor cephalothoracico-pleural suture to its carapace, and in the branchial system, which is invariably furnished with an epipodite in the twelfth somite and with a filamentous vestige of an anterior arthrobranchia in the thirteenth.

Type *Penæus affinis*, H. Milne-Edw.

The first two of the three following species are referred with some confidence to this genus as little-modified deep-sea representatives of it, the third with some doubt, as it lacks the branchial rudiment.

5. [*Metapenæus philippinensis*, var. *andamanensis*, nov.

Penæus philippinensis, Sp. Bate, 'Challenger' Macrura, 1888, p. 261, pl. xxxv. figs. 2, ♀, 3, ♂.

Differs from the specimens described and figured by Spence Bate in its much smaller size and in the median part of the *annulus ventralis* being shorter and devoid of lateral notches. The rostrum is in both sexes almost straight and scarcely ascendant; in the largest female it extends somewhat beyond, in the other females and in a male barely to, the end of the penultimate joint of the antennulary peduncle. The legs of the first pair are furnished with a spine at the ventral apex of their second and third joints. In the female there is a pair of sternal spines between the second pair of legs similar to, but very much smaller than, those present in *M. velutinus*

(Dana). The inner flagellum of the antennules is short and but little longer than the outer, and is unmodified at base in the male. The dorsal carina of the abdomen commences in the second somite as a faint and blunt elevation of the anterior half of the tergum, and is continuous and distinct from the base of the third to the extremity of the last tergum, at which it ends in a single minute point, being cleft so as to terminate in two points in each of the three penultimate terga. In addition to the median carina the three terminal somites present on each side of the middle line a tolerably distinct blunt subdorsal angulation, hence appearing to be tricarinate.

The caudal swimmerets when laid back extend much beyond the apex of the telson, and the outer margin of their exopodites runs out into a spine a good way from the apex of the joint—primitive features which are not noticed in Spence Bate's description, though the former of them is brought out in the accompanying drawings of the typical form.

The largest female measures about 63 millim., the only male about 51 millim., in a straight line from the apex of the rostrum to that of the telson.

One nearly mature male with four females from north of Port Blair, Andaman Sea, in 112 to 244 fathoms, on 29th Nov., 1888.]

6. *Metapenæus coniger*, sp. n.

Differs from the preceding in the following points:—The inner flagellum of its longer antennules is fully twice as long as the outer, and in the male bears at its inner and upper margin near the base a short, stout, and highly indurated spine of a peculiar form, the part from which the spine springs being conically thickened and elevated, with its constituent joints firmly ankylosed together. The three terminal abdominal terga are much more strongly angulated subdorsally. The *annulus ventralis* of the female is built precisely upon the same plan as in *M. philippinensis*, and represents, there is little doubt, a primitive phase in the evolution of the organ, though at first sight it appears to be so strikingly different; its posterior moiety is a roughly semicircular concave plate with prominent raised anterior and lateral margins, and it abuts by its deeply bifid anterior margin against the anterior moiety, which has the form of a short and broad band; its raised anterior border has an outline intermediate between that of a capital T and a capital Ƭ, the ends of the cross stroke of which are in the same curved line with the raised lateral margins, and do not nip the sides of

the grooved downstroke, as in *M. philippinensis.* It is easy to be seen that the condition of parts manifested by the preceding species has been brought about by the expansion, leaf-like, of the Υ-shaped ridge in all its parts, whereby the anterior ends of the lateral margins have been thrust inwards and backwards against the expanded anterior margin, so that the latter appears to be "held in position by clamp-like lateral processes." The legs of the first pair have a spine on the second and third joints below. There is a very minute pair of sternal spines between the second pair of legs in the female; they are, however, much smaller than in the preceding species, and it is hence possible that they may be really absent or so small as to be readily overlooked in the specimens described by Spence Bate, who expressly states that none are present.

The branchial formula is:—

Somites and their appendages.	Podobranchiæ.	Arthrobranchiæ. Anterior.	Arthrobranchiæ. Posterior.	Pleurobranchiæ.		
VIII.	1	1	1	0	=	3
IX.	0	1	1	1	=	3
X.	0 (*ep.*)	1	1	1	=	3+*ep.*
XI.	0 (*ep.*)	1	1	1	=	3+*ep.*
XII.	0 (*ep.*)	1	1	1	=	3+*ep.*
XIII.	0	*r.*	1	1	=	2+*r.*
XIV.	0	0	0	0	=	0
	1+3 *ep.* +	5+*r.* +	6 +	5	=	17+*r.*+3 *ep.*

The branchiæ are voluminous and remarkably laxly constructed and feathery, with an unusually well-developed terminal plume. The anterior arthrobranchia of the penultimate somite is represented by a simple filament. The last epipodite (XII.) is branched.

Length, from tip of rostrum to tip of telson, ♂ 77 millim., ♀ 88 millim.; of carapace, from supra-orbital margin to middle of posterior margin in a straight line, ♂ 18 millim., ♀ 20·5 millim.; of abdomen, ♂ 45 millim., ♀ 49 millim.; of inner flagellum of antennules, ♂ 16·5 millim., ♀ 17·5 millim.; of outer flagellum of antennules, ♂ 8 millim., ♀ 7·5 millim.

Nine males and eleven females from Station 119, 95 fathoms. It had previously been obtained in considerable numbers off the Mahánaddi Delta in 68 fathoms (32 ♂ and 26 ♀), and at Station 96, 98 to 102 fathoms (4 ♂ and 10 ♀), the colour of which last was noted as transparent grey irregularly suffused with pink.

Both the preceding are remarkable for the membranous condition of the lower part of the branchiostegite in apparent correlation with the voluminous and feathery character of the branchiæ.

7. *Metapenæus rectacutus* (Sp. Bate).

Penæus rectacutus, Sp. Bate, 'Challenger' Macrura, 1888, p. 266, pl. xxvi. fig. 2 (excl. 2 *z*), ♀.

Two fine females from Station 115, 188 to 220 fathoms.

Colour in life red.

The carapace and abdomen are perfectly glabrous throughout. The former is armed with three spines, an antennal, an hepatic, and a branchiostegal. From the last-named of these a sharp crest curves boldly upwards and backwards, forming the lower boundary of the anterior end of the cervical groove as far as the level of the hepatic spine, whence it is continued nearly to the posterior end of the carapace as a blunt ridge—the cardio-branchial—which, with the branchiostegal crest, marks out the upper boundary of the subjacent branchial chamber; similarly, a sharp crest continued straight upwards and backwards from the hepatic spine accentuates the gastro-hepatic groove.

The 13- to 14-toothed rostrum is neither quite so stout nor quite so straight as represented by Spence Bate. The exopodites of the thoracic legs are rudimentary. The all but equal antennulary flagella are about as much shorter than the carapace, measured from the frontal to the middle of the posterior margin in a straight line, as they are longer than the rostrum measured from the same point in the same manner.

The telson is strongly trifurcate and armed at the sides, in front of the lateral prongs, with three pairs of small movably-articulated spines, which are separated from one another and from the lateral prongs by intervals equal to about twice their own length.

The branchial formula is :—

Somites and their appendages.	Podobranchiæ.	Arthrobranchiæ. Anterior.	Arthrobranchiæ. Posterior.	Pleurobranchiæ.	
VIII.	1	1	1	0	= 3
IX.	0	1	1	1	= 3
X.	0 (*ep.*)	1	1	1	= 3+*ep.*
XI.	0 (*ep.*)	1	1	1	= 3+*ep.*
XII.	0 (*ep.*)	1	1	1	= 3+*ep.*
XIII.	0	0	1	1	= 2
XIV.	0	0	0	0	= 0
	1+3 *ep.* +	5 +	6 +	5	=17+3 *ep.*

The last epipodite (XII.) is simple and unbranched, and there is no vestige of an anterior arthrobranchia in the thirteenth somite.

Length, from rip of rostrum to tip of telson, 113 to 129 millim.; length of carapace 25·5 to 29·5 millim.; of rostrum 21·5 to 24 millim.; of antennulary flagella 23 to 26 millim.

The three preceding species, in common with other infralittoral allies of littoral forms, seem to be in many respects in a more primitive phase of evolution than their littoral allies. Their primitive characters are (1) that the last abdominal segment is elongate, (2) that the caudal swimmeret is more natatory, as evidenced by its being prolonged far beyond the level of the marginal spine of the exopodite, and (3) that the telson is trifurcate and spinulose at the sides.

In the first two of these characters they recall many of the true deep-sea Penæidæ, many of the Schizopoda (e. g. *Gnathophausia*), and the final larval stages of their own kind; while the lateral prongs and spines of their telson are to be interpreted as the modified vestiges of the larval caudal fork, which, it may be remarked, persists throughout life almost unchanged in at least one Penæid, viz. *Sicyonia furcata.*

Subfamily *Solenocerina.*

Solenocera, Lucas.

8. *Solenocera Hextii*, W.-M.

Solenocera Hextii, Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. 1891, p. 188, ♂ ♀.

Nine males and six females from Station 119, 95 fathoms, including a full-grown pair, which prove that the rostrum of the fully adult female is shorter, broader, and more ascendant than in the juvenile stages, and that that of the male, while retaining the length and breadth it has in youth, is deflexed with the line of the teeth decidedly convex; length of the large female about 75 millim., of the male about 67 millim.

Also a mutilated male from Station 120, 240 to 276 fathoms.

This species has a distinct supra-orbital angle, which is not, however, spinose, a post-orbital spine, a small hepatic spine, and a third spine smaller than this on the edge of the gastro-hepatic crest, but no branchiostegal spine.

The telson is trifurcate.

The common Indian littoral form (? *P. crassicornis*, M.-

Edw.) also is without branchiostegal spines, and, moreover, has the telson simple and unarmed.

The branchial formula is the same in both species, namely:—

Somites and their appendages.	Podo-branchiæ.	Arthrobranchiæ. Anterior.	Arthrobranchiæ. Posterior.	Pleuro-branchiæ.		
VIII.	1	1	1	0	=	3
IX.	0 (*ep.*)	1	1	1	=	3+*ep.*
X.	0 (*ep.*)	1	1	1	=	3+*ep.*
XI.	0 (*ep.*)	1	1	1	=	3+*ep.*
XII.	0 (*ep.*)	1	1	1	=	3+*ep.*
XIII.	0 (*ep.*)	1	1	1	=	3+*ep.*
XIV.	0	0	0	1	=	1
	1+5 *ep.* +	6 +	6 +	6	=	19+5 *ep.*

PARASOLENOCERA, gen. nov.

Carapace grooved as in *Solenocera*, furnished with supraorbital, postorbital, and hepatic spines; without post-rostral ridge. Abdomen narrow and elongated, with a conspicuous hump, giving to the body a decided wasp-waisted appearance, dorsally carinated from the base of the third tergum to the apex of the last—the carina very distinctly and increasingly cristiform from the base of the fourth to the apex of the last, where it ends in a sharp decurved spine. Telson trifurcate, as long as the swimmerets. Flagella of antennules foliaceously expanded, tapering gradually to a very fine setaceous point, the inner much the broader and a little the longer, ensheathing the outer.

This genus forms a connecting-link between *Solenocera* on the one hand and *Hymenopenæus*, *Philonicus*, and *Haliporus* on the other.

9. *Parasolenocera annectens*, sp. n.

The strongly ascendant and very slightly upcurved rostrum is regularly and rather gradually produced to a very sharp point, which reaches almost to the end of the penultimate joint of the antennulary peduncle. It is armed with a decreasing series of eight excessively acute teeth, the first of which is placed on the gastric region and about as distant from the second as this is from the fourth of the series.

The first branchiostegal spine when viewed from the side presents itself as a stout, compressed, acute, triangular pro-

longation of the anterior end of the inflated outer wall of the efferent branchial channel, or—what comes to the same thing—of the branchiostegal crest, which is not continued to the anterior margin of the carapace.

The eyes are large and reniform.

A single female from Station 116, 405 fathoms.

Colour in life red.

Length, from apex of rostrum to apex of telson 66 millim.; of abdomen 40 millim.; of carapace, from supra-orbital to posterior margin, 16 millim.; of rostrum, from same point, 8 millim.; of outer antennulary flagellum 19 millim., of inner 21 millim.

HYMENOPENÆUS, S. I. Smith.

10. *Hymenopenæus microps*, S. I. Smith.

Hymenopenæus microps, S. I. Smith, Ann. Rep. Comm. Fish. 1884, p. 413 (69), pl. x. fig. 1; Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. p. 188.

A female from Station 112, 561 fathoms.

HALIPORUS, Sp. Bate.

This genus is probably identical with *Hymenopenæus*, Smith.

11. *Haliporus æqualis*, Sp. Bate.

Haliporus æqualis, Sp. Bate, 'Challenger' Macrura, 1888, p. 285, pl. xli. fig. 1.

We do not verify the sexual difference between the male and female in the direction of the rostrum, which is armed with from seven to nine teeth, of which those on the gastric region are constantly two.

The propodite of the last pair of legs in the male at all events is more than four times the length of the dactylopodite, while in the penultimate pair it is only twice as long. The almost level crest of the last abdominal somite ends in a small spine. The trifurcate telson is much shorter than the swimmerets.

The outer flagellum of the antennules is at least three times as long as the inner, which are equal in length to the carapace measured from the tip of the rostrum to the middle of the hinder margin.

Four males and a female from Station 115, 188 to 220

fathoms; and one male and a young one from Station 116, 405 fathoms.

Colour in life pink.

12. *Haliporus neptunus*, Sp. Bate.

Haliporus neptunus, Sp. Bate, 'Challenger' Macrura, 1888, p. 291, pl. xlii. fig. 3.

In our specimens the rostrum is sharper and more ascendant, and the crests of the last three abdominal terga are spinose at the extremity, the spine in the first two springing from the bottom of the median cleft.

The telson, which is trifurcate, reaches about midway between the outer and inner lamellæ of the swimmerets when these are laid back.

In addition to an extra-ocular plate and antennal, post-antennal, hepatic, and post-branchiostegal spines, there is a true branchiostegal spine.

There is a still greater disproportion between the propodite and dactylopodite of the last pair of legs than in the last species.

One female from Station 111, 1644 fathoms, and two from Station 117, 1748 fathoms.

Colour in life lurid orange.

Subfamily *Aristæina*.

Aristæus, Duvernoy.

Aristeus, Duvernoy, Ann. des Sc. Nat., Zool. 1841 (ii.), xv. pp. 101 *et seq.*

Hemipenæus, Sp. Bate, 'Challenger' Macrura, 1888, p. 299 (ex parte).

Rostrum three-toothed; carapace without hepatic spine; antennal scale large; mandibular palp thin and foliaceous, with terminal joint triangular; dorsal carina of last three abdominal terga terminating posteriorly in a spine; postero-lateral angles of abdominal pleura simple and unarmed; legs without exopodites; dactylopodites of the last two pairs of legs setaceous.

The branchial formula of *Aristæus virilis*, Spence Bate, is as follows:—

Somites and their appendages.	Podobranchiæ.	Arthrobranchiæ. Anterior.	Arthrobranchiæ. Posterior.	Pleurobranchiæ.		
VIII.	1	0	1	0	=	2
IX.	1	1	1	*r.*	=	3+*r.*
X.	1	1	1	*r.*	=	3+*r.*
XI.	1	1	1	*r.*	=	3+*r.*
XII.	0 (*ep.*)	1	1	*r.*	=	2+*r.*+*ep.*
XIII.	0	1	1	*r.*	=	2+*r.*
XIV.	0	0	0	1	=	1
	4+*ep.* +	5 +	6 +	1+5 *r.*	=	16+5 *r.*+*ep.*

The functional branchiæ are sixteen in number, arranged in two series, an outer and an inner. The outer series consists of eleven, namely podobranchia VIII., anterior arthrobranchia IX., podobr. IX., anterior arthrobr. X., podobr. X., anterior arthrobr. XI., podobr. XI., anterior arthrobr. XII., anterior arthrobr. XIII., posterior arthrobr. XIII., pleurobranchia XIV.; and the inner series of five, namely posterior arthrobr. VIII., posterior arthrobr. IX., posterior arthrobr. X., posterior arthrobr. XI., and posterior arthrobr. XII. The number of functional branchiæ thus corresponds exactly with the description and figures of Duvernoy, while their arrangement differs but slightly therefrom—the difference consisting in posterior arthrobranchia XII. occupying the last place in the inner series instead of the ninth place in the outer series, as in the typical form. There is but one fully developed and functional pleurobranchia, namely that of somite XIV., the remaining five being reduced to minute rudimentary plumes of no functional importance.

Type *Aristæus antennatus*, Duvernoy.

13. *Aristæus virilis* (Sp. Bate).

Hemipenæus virilis, Sp. Bate, 'Challenger' Macrura, 1888, p. 303, pl. xliv. fig. 4, ♂.

Hemipenæus tomentosus, id. ibid. p. 307, pl. xlix. figs. 2, 3, pl. l., ♀.

These two species have been separated by Spence Bate on differences which prove to be sexual.

The remarkable structure of the base of the inner flagellum of the antennules (which probably forms an apparatus for holding the female, and recalls the structure of the same part in our *Metapenæus coniger*) and the thickening of the tissues of the outer apex of the antennal scale (of which the remarkable prolongation of the apex of the same part in *Aristæopsis Edwardsiana* is only an extension) have been indicated by Mr. Spence Bate.

To the above we may add that the rostrum, which in

females and in the young of both sexes ends in a long styliform process extending far beyond the peduncles of the antennules, in the adult male is so shortened as to scarcely pass beyond the end of the first joint of these appendages. The only absolute difference which I have been able to detect between our specimens and Duvernoy's figures and descriptions is in the arrangement of the branchial plumes above described.

Very many specimens of both sexes from Station 115, 188 to 220 fathoms. Several specimens had been previously obtained in the same part of the Andaman Sea in 271 fathoms.

Colour in life red.

14. *Aristæus semidentatus* (Sp. Bate).

Hemipenæus semidentatus, Sp. Bate, 'Challenger' Macrura, p. 305, pl. xlix. fig. 1, ♀.

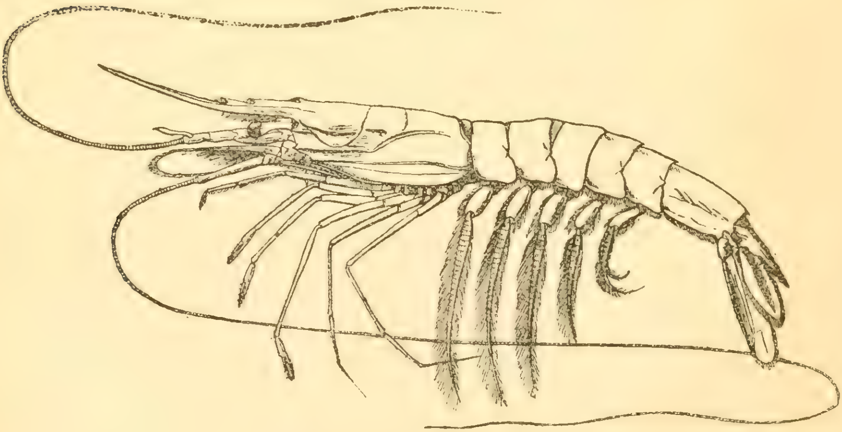
Very many specimens of both sexes from Station 120, 240 to 276 fathoms. Previously obtained in lat. 20° 17′ 30″ N., long. 80° 50′ E., in 193 fathoms, and from the Swatch-of-No-ground in 405 to 285 fathoms.

This species presents precisely the same sexual characters as the preceding, from which, so far as we have been at present able to make out, it only differs in being quite glabrous and as a rule smaller.

15. *Aristæus coruscans*, sp. n.

Body elongate, slender, glabrous. Rostrum long, extending by nearly one half of its length beyond the peduncles of

Fig. 6.



Aristæus coruscans, ♀, ⅔ nat. size.

the antennules, its basal toothed portion almost horizontal, its apical portion long, slender, styliform, straight, and ascendant: the first tooth arises just at the level of the supraorbital margin, its ridge extending as a sharpish and diminishing dorsal crest nearly to the hinder edge of the carapace; the second arises about the length of an eye-peduncle from the first, and the third about half that distance from the second. A long postorbital crest commences close behind the orbital margin, and extends without interruption to the gastro-hepatic groove, where it ends, to reappear again in the interval between the gastro-hepatic and cervical grooves; the crest of the antennal spine is short, extending only to the antennal groove; the long crest of the branchiostegal spine runs horizontally backwards as far as the curved cardio-branchial ridge and groove, which with it demarcates the upper boundary of the subjacent branchial chamber; below the branchiostegal crest a ridge of nearly the same strength delimits the indurated superior from the membranous inferior part of the sides of the carapace and anteriorly runs to the anterior margin, while posteriorly it is continuous with the raised rim of the posterior margin on each side.

The legs are slender and weak.

A fine female from Station 112, 561 fathoms.

Colour in life bright orange.

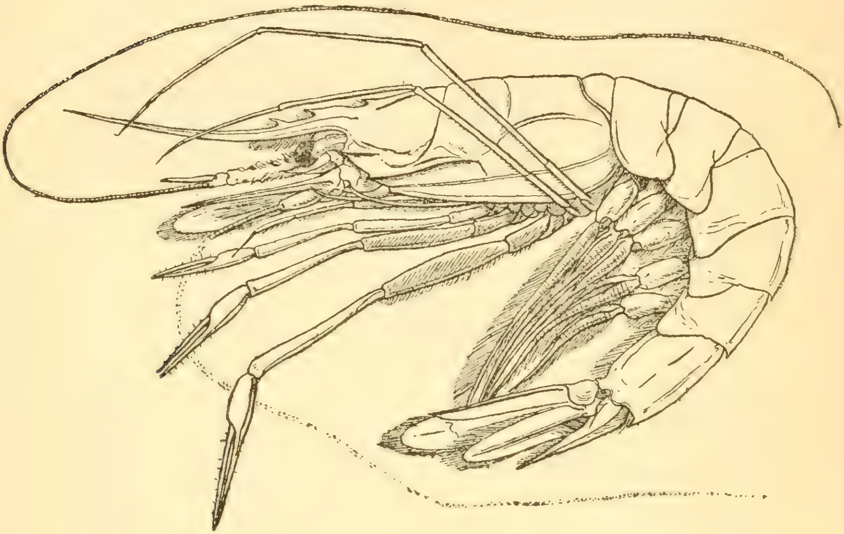
The specimen was strongly luminous when first brought on board.

16. *Aristæus crassipes*, sp. n.

Body pubescent. Rostrum long, extending by fully one half of its length beyond the peduncles of the antennules; its basal toothed portion slightly descendant, its apical portion, which is excessively slender and styliform, ascends in a faint curve to its excessively fine and sharp point; the first tooth arises well to the rear of the orbital margin, the second about the length of an eye-peduncle from the first, and the third about two-thirds of that distance from the second; the crest of the first extends backwards as a blunt dorsal ridge to about midway between the cervical groove and the hinder margin of the carapace; a blunt postorbital crest defines the antennal groove superiorly, and an almost equally blunt short crest to the antennal spine limits it below; the crest of the branchiostegal spine is somewhat stronger and sharper than in the preceding species, but presents similar relations to the cardio-branchial groove, at its junction with which a groove passes off obliquely downwards and backwards towards but not up

to the ridge separating the hard and the soft parts of the sides of the carapace from one another; both gastro-hepatic and cervical grooves are rather more strongly marked than in the preceding species, especially the latter of them, which is

Fig. 7.



Aristæus crassipes, ♀, natural size.

accentuated by a slight thickening of the integument immediately behind it on each side of the middle line; neither, however, actually indents the dorsal ridge, though both appear to do so from the lateral aspect, as is seen in the accompanying figure.

The thick and robust first three pairs of chelate limbs present the most marked contrast to the thin and filiform last two pairs.

A fine female specimen from Station 116, 405 fathoms.

Colour in life crimson.

An equally fine example of the same sex had previously been obtained in lat. 6° 29′ N., long. 79° 34′ E., in 597 fathoms.

ARISTÆOPSIS, gen. nov.

Aristeus, Sp. Bate, 'Challenger' Macrura, 1888, p. 309 (non Duvernoy).

Rostrum three-toothed; carapace without hepatic spine;

antennal scale large; mandibular palp robust, with terminal joint bifurcate; dorsal carina of the last four abdominal terga terminating posteriorly in a spine; postero-lateral angles of second or third to fifth abdominal pleura minutely mucronate; legs with or without minute exopodites; dactylopodites of the last two pairs of legs lanceolate, smooth and convex below, flat or concave and fringed with hairs on both edges above.

Branchial formula of *Aristæopsis Edwardsiana* (Johnson):—

Somites and their appendages.	Podobranchiæ.		Arthrobranchiæ. Anterior.		Arthrobranchiæ. Posterior.		Pleurobranchiæ.		
VIII.	1		0		1		0	=	2
IX.	1		1		1		1	=	4
X.	1		1		1		1	=	4
XI.	1		1		1		1	=	4
XII.	1		1		1		1	=	4
XIII.	0 (*ep.*)		1		1		1	=	3+*ep.*
XIV.	0		0		0		1	=	1
	5+*ep.*	+	5	+	6	+	6	=	22+*ep.*

It differs from *Aristæus* in having a fully developed (=plume and epipodite) podobranchia XII. and an epipodite XIII., with a regularly decreasing series of pleurobranchiæ, the anterior five of which are degenerate as to their pinnules, but not reduced in length, and hence cannot be called rudimentary.

Type *Penæus Edwardsianus*, Johnson, P. Z. S. 1867, p. 897, ♀ = *Aristeus coralinus*, A. M.-Edw. in 'Challenger' Macrura, 1888, pl. xxxii. fig. 10, ♂.

[*Obs. Funchalia*, which is entered by Spence Bate as a synonym of his *Aristeus* (=*Aristæopsis*), has, as Johnson's description proves, nothing whatever to do with either *Aristæopsis* or *Aristæus*, and probably does not even belong to the Aristæine alliance at all, having, among other things, an unarmed abdomen and the mandibles in the form of "long sickle-shaped shears which cross each other from opposite sides of the mouth." Now all the Aristæine Penæids without exception have an armed abdomen and mandibles which depart little, if at all, from the normal form.]

17. *Aristæopsis Edwardsiana*, Johns.

Penæus Edwardsianus, Johnson, P. Z. S. 1867, p. 897, ♀.
Aristeus Edwardsianus, Miers, P. Z. S. 1878, pp. 308, 309, pl. xvii. fig. 3, mandibular palpus.

Aristeus coralinus, A. M.-Edw. in 'Challenger' Macrura, 1888, pl. xxxii. fig. 10, ♂, antennal scale.

An adult male and an adolescent male with commencing process of the antennal scale, and an adult female, from Station 115, 188 to 220 fathoms.

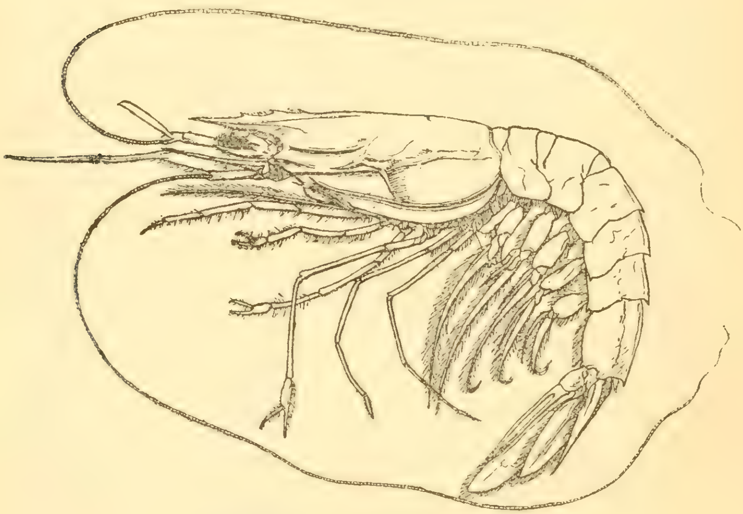
Colour in life deep crimson.

Two males and a very fine full-grown female had been taken off Port Blair in 271 fathoms, and a young specimen in the Gulf of Manaar in 597 fathoms.

Our specimens of the female agree absolutely with Johnson's admirable description.

Adult males present some remarkable sexual differences; not only is their rostrum short and porrect, not extending beyond the apex of the antennulary peduncles, but their antennal scale is prolonged at the apex into a slender cylindrical fleshy process as long as the scale itself. This process,

Fig. 8.



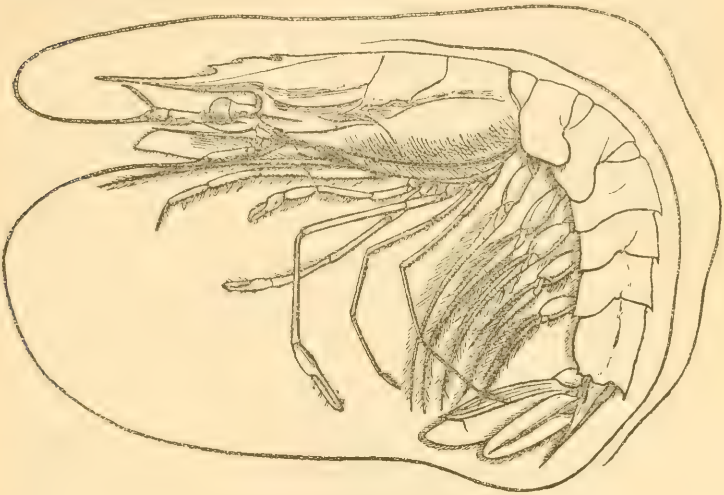
Aristæopsis Edwardsiana, ♂, × ½.

which is an extension of the thickening of the tissues seen in *Aristæus virilis* and others, is longitudinally grooved dorsally and is of uniform width from near the base to the blunt apex.

With growth the rostrum of the female also undergoes considerable reduction in length; but it always exceeds the antennulary peduncle.

The dorsal ridge of the abdomen commences on the second tergum. The second (Atlantic) or third (Indian) to fifth pleura are minutely mucronate; in one of our specimens a very minute mucro can be made out on one of the pleura of the second tergum.

Fig. 9.



Aristæopsis Edwardsiana, ♀, × $\frac{1}{2}$.

18. *Aristæopsis armata* (Sp. Bate).

Aristeus armatus, Sp. Bate, Ann. & Mag. Nat. Hist. (5) viii. 1881, p. 188; id. 'Challenger' Macrura, 1888, p. 312, pls. xlv., xlvi., ♂ ♀.
Aristeus? tridens, S. I. Smith, Ann. Rep. U. S. Comm. Fish. 1884, p. 404, ♂ ♀, (60), pl. x. fig. 1, ♂.

A magnificent example of an apparently adult male from Station 117, 1748 fathoms.

Colour in life deep crimson.

It measures no less than 270 millim. in length from the tip of the rostrum to the tip of the telson.

It exhibits a thickening of the tissues of the apex of the antennal scale, but shows no sign of reduction in the length of the rostrum met with in other species.

The dorsal ridge of the abdomen commences in the third tergum. The abdominal pleura from the third or fourth to the fifth are minutely mucronate.

Mandibles as in S. I. Smith's figures.

The inner branches of the caudal swimmeret when laid back reach to the end of the telson.

ARISTÆOMORPHA, gen. nov.

Rostrum many-toothed; an hepatic spine is present; mandibular palp robust, with terminal joint subbifurcate; antennal scale small; postero-lateral angles of abdominal pleura second to fifth simple and unarmed; dorsal carina of the last four abdominal terga ending in a spine; legs without exopodites; dactylopodites of the last two pairs setaceous; branchial formula as in *Aristæopsis*, according to Spence Bate.

Type *Aristeus rostridentatus*, Sp. Bate.

[19. *Aristæomorpha rostridentata* (Sp. Bate).

Aristeus rostridentatus, Sp. Bate, 'Challenger' Macrura, 1888, p. 317, pl. li., ♀.

A fine female was taken in a previous season off Port Blair in the Andaman Sea, 271 fathoms.]

HEMIPENÆUS, Sp. Bate (p.).

20. *Hemipenæus Carpenteri*, W.-M.

Hemipenæus Carpenteri, W.-M., Ann. & Mag. Nat. Hist. (6) vii. 1891, p. 189, ♀.

A female from Station 106, 1091 fathoms.

Colour in life transparent orange.

It has four spines to the rostrum, the additional spine being developed in front of the normal three.

A young specimen from Station 111, 1644 fathoms, colour in life orange, has the normal number of spines to the rostrum.

A female from the Bay of Bengal, 1300 fathoms, has only two teeth to the rostrum, the apical one being apparently absent.

Having only four females, and those differing, we are not in a position to attempt the determination of the relation of this species to other forms, and so leave it for the present in Spence Bate's genus.

Subfamily? *BENTHESICYMINA*.

GENNADAS, Sp. Bate.

21. *Gennadas parvus*, Sp. Bate.

Gennadas parvus, Sp. Bate, Ann. & Mag. Nat. Hist. (5) viii. 1881, p. 191; id. 'Challenger' Macrura, 1888, p. 340, pl. lix.

Gennadas parvus, Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. p. 189, ♂ ♀.

? *Amalopenæus elegans*, W.-M., *loc. cit.*

One male from Station 108, 1043 fathoms; another from Station 109, 738 fathoms; and a third from Station 111, 1644 fathoms; all of a uniform deep lake-colour.

[To be continued.]

XXXIII.—*Eleventh Contribution to the Knowledge of the Fauna of Madagascar* *. By Dr. A. Günther, F.R S.

[Plate XIV.]

Chamæleon longicauda, sp. n. (Pl. XIV.)

Occiput rather raised in the middle, a distinct crest dividing the crown into two halves. No occipital lobes. The supraorbital margin continued as a prominent ridge along the canthus rostralis, slightly projecting in front of the snout. Scutes covering the head rather large. Body coarsely tubercular, larger tubercles being interspersed among the small ones. A distinct gular row of pointed tubercles passes without interruption into the ventral series. A dorsal crest of short, pointed, conical tubercles. No tarsal spur. Greenish; a rather broad, whitish, black-edged band runs from the tympanic region above the shoulder along the side of the body.

An adult male is nearly 15 inches long, the tail measuring 8 inches.

Anorontsangana (N.W. Madagascar).

Hoplurus sebæ (Fitz.) occurs in the same locality.

A small collection made at Senbendrana contained *Rana biporus* (Blgr.), *Polypedates Crossleyi* (Ptrs.), *Rhacophorus luteus* (Blgr.), *Geckolepis maculata* (Ptrs.), and what appears to be an undescribed species of *Lygodactylus*.

Lygodactylus miops, sp. n.

This species is allied to *Lygodactylus madagascariensis*, differing by the larger size of its eye.

Three small scales between the nasals; two large scales behind the chin-shield. Nostril above the suture between the rostral and first labial. Eye large, two thirds of the length of the snout, the snout being equal in length to the distance between the eye and the ear-opening. Upper labials seven. Skin finely granular. Tail below with imbricate scales, but without a median series of larger and broader scales. A brownish-yellow longitudinal band starts from

* 10. "Tenth Contribution to the Knowledge of the Fauna of Madagascar," Ann. & Mag. Nat. Hist. 1890, v. p. 69.

the eye and is continued along the side of the back to the root of the tail, where it joins that of the other side; it is broadly edged with brownish black above and below, the edges being interrupted and more indistinct in the posterior half of the length of the body. Throat finely speckled with black; lower parts of the body uniform whitish.

Total length 53 millim., the tail measuring 23 millim.

XXXIV.—*On new or little-known Indian and Malayan Reptiles and Batrachians.* By G. A. Boulenger.

Draco quinquefasciatus, Gray.

This beautiful lizard was described in 1827 from a single male specimen from Penang. A second specimen, likewise a male, from the same locality, was recorded by Stoliczka in 1873. The British Museum has now received a female specimen obtained on Mount Dulit, Borneo, by Mr. C. Hose.

Aphaniotis acutirostris, Modigliani.

A specimen from Western Borneo, presented to the British Museum by Mr. J. Deby, has all the characters of this species, recently distinguished from Peters's *A. fusca.*

Calotes andamanensis, sp. n.

Upper head-scales moderate, subequal, obtusely keeled; tympanum not quite half the diameter of the orbit. An oblique, curved fold in front of the shoulder. Nuchal crest well developed, composed of erect spines, the longest of which equal the diameter of the tympanum; dorsal crest a mere denticulate ridge. Sixty-three scales round the middle of the body; dorsal scales larger than ventrals, very feebly keeled, nearly smooth, the upper pointing upwards, the lower pointing downwards; ventral scales strongly keeled and larger than the gulars. The adpressed hind limb reaches the eye; third and fourth fingers equal, as long as the fifth toe. Tail feebly compressed at the base, with slight upper ridge. Green above, with whitish spots on the body; tail with blackish annuli.

	millim.
Total length	247
Head	23
Width of head	14
Body	64
Fore limb	42
Hind limb	66
Tail	160

A single specimen, from the Andaman Islands, is preserved in the Copenhagen Museum, and was communicated to me by Prof. Lütken.

This *Calotes* finds its nearest ally in the Ceylonese *C. liolepis*, which differs in its much larger scales and the presence of a pair of spine-like scales on each side of the back of the head.

Lygosoma subcœruleum, sp. n.

Section *Keneuxia*. Habit lacertiform; the distance between the end of the snout and the fore limb contained once and one fourth in the distance between axilla and groin. Snout rather elongate, obtusely pointed, much depressed. Lower eyelid scaly. Nostril pierced in the middle of a small nasal; a supranasal, not in contact with its fellow; frontonasal a little broader than long, in contact with the rostral; præfrontals forming a median suture; frontal only a little longer than the interparietal, in contact with the first and second supraoculars; four supraoculars, second largest; nine supraciliaries; frontoparietals and interparietal distinct, subequal, the latter separating the parietals; a pair of nuchals; four labials anterior to the subocular. Ear-opening very small. Twenty-eight scales round the middle of the body, dorsals feebly striated and a little larger than ventrals. Digits moderately elongate, with strong sharp claws, the basal phalanges somewhat depressed, the distal strongly compressed; subdigital lamellæ smooth, fourteen under the fourth toe. Bronzy olive above, with small whitish black-edged spots; a dark streak from the eye to the shoulder and a pair of black streaks on the back of the head and nape; lower parts blue.

	millim.
Total length	120
Head	15
Width of head	8
Body	45
Fore limb	18
Hind limb	23
Tail	60

A single specimen from Bodanaikanur, Travancore, presented to the British Museum by Mr. H. S. Ferguson.

Gonyophis, gen. nov.

Maxillary teeth twenty-three, equal; mandibular teeth subequal. Head distinct from neck, elongate; eye moderate, with round pupil. Body elongate, a little compressed; scales feebly keeled, with apical pits, in nineteen rows; ventrals with a suture-like lateral keel, and a notch on each side corresponding to the keel. Tail long; subcaudals in two rows, keeled and notched like the ventrals.

A single species—*Gonyophis margaritatus* (*Gonyosoma margaritatum*, Peters, Mon. Berl. Ac. 1871, p. 578, and Ann. Mus. Genova, iii. 1872, p. 39, pl. v. fig. 3).

The type is from Borneo; I have examined a large male specimen from Singapore, which formed part of the Raffles Museum, and is now preserved in the Indian Museum, Calcutta. It has 230 ventrals and 115 pairs of subcaudals; its colour is green above, with black borders to the scales, yellowish beneath, with the shields black-edged; hinder part of body and tail with bright orange rings.

G. margaritatus combines the general characters of *Coluber* with the ventral scutellation of *Dendrophis*.

Zamenis fasciolatus, Gthr.

Has been found at Gwalior by Mr. C. Maries.

Rana Hosii, sp. n.

Vomerine teeth in two strong oblique series extending posteriorly much beyond the level of the hinder edge of the choanæ. Head slightly longer than broad; snout as long as the diameter of the orbit, subacuminate, feebly prominent; canthus rostralis distinct; loreal region oblique and deeply concave; nostril nearer the end of the snout than to the eye; interorbital space as broad as the upper eyelid; tympanum very distinct, half the diameter of the eye. Fingers and toes moderately elongate and expanded at the end into large disks, those of the outer fingers as large as the tympanum; first finger not extending beyond second; toes webbed to the disks; subarticular tubercles well developed; inner metatarsal tubercle elliptic, feebly prominent; no outer metatarsal tubercle. The femoro-tibial articulation reaches the axilla, the tibio-tarsal beyond the end of the snout. Upper parts

finely granular; a feebly prominent glandular dorso-lateral fold. Uniform purplish brown above, limbs with very indistinct darker cross bars; loreal and temporal regions rather darker; upper lip and lower parts white.

From snout to vent 95 millim.

A single female specimen was obtained by Mr. C. Hose in Borneo, on Mount Dulit.

Rana nicobariensis, Stoliczka.

Specimens recently obtained by my colleague Mr. R. Kirkpatrick at Salak, Java, and which agree in every point with *Rana macularia*, var. *javanica*, of Horst (Notes Leyd. Mus. v., 1883, p. 243), add to our knowledge of the distribution of this frog, which was originally described from the Nicobars, but has since been recorded from Sumatra and Nias.

Rana glandulosa, Blgr.

This Bornean frog has recently been rediscovered at Malacca by Mr. Davison.

Ixalus travancoricus, sp. n.

Snout rounded, as long as the diameter of the orbit; canthus rostralis obtuse; loreal region slightly concave; nostril much nearer the end of the snout than to the eye; interorbital space broader than the upper eyelid; tympanum hidden. Fingers free; toes one-third webbed; disks well developed; metatarsal tubercle flat, very indistinct. The tibio-tarsal articulation reaches the eye. Skin smooth, granular on the belly and under the thighs. Cream-colour above, minutely dotted with black; some larger black dots scattered on the back and on the tibia; a black streak from shoulder to shoulder round the snout, passing through the eyes and the nostrils; a blackish streak on each side of the anterior half of the back; a narrow band of pigment along the upper surface of the femur; belly white, the other parts colourless.

From snout to vent 31 millim.

This species is described from a single specimen, a gravid female, obtained by Mr. H. S. Ferguson at Bodanaikanur, Travancore, at the foot of the hills on the eastern side, in May 1891.

Ixalus signatus, Blgr.

This Southern-Indian species also inhabits Ceylon. A specimen from Punduloya, 5000 feet, has been presented to the British Museum by Mr. E. E. Green.

Bufo quadriporcatus, Blgr.

This toad was described in 1887 from a specimen obtained near Malacca. It has since been recorded by Günther from Perak and by me from Deli, Sumatra. I can now add Borneo to its habitat, a fine female specimen having been discovered by Mr. Hose on Mount Dulit.

XXXV.—*On a Stegosaurian Dinosaur from the Trias of Lombardy.* By G. A. Boulenger.

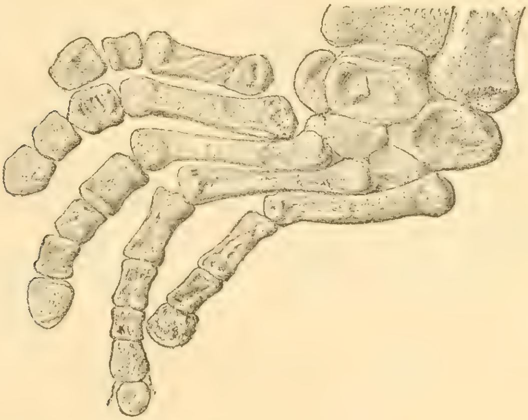
I have long been puzzled by a cast of a remarkably well-preserved small Dinosaurian foot found among unclassified material in the museum of the Royal College of Surgeons, labelled "Cast of the foot of fossil Reptile from the Lias of Esino, in Lombardy. The original at Milan." The well-known Esino beds of Lombardy do not, however, belong to the Lias, but to the Upper Trias (Keuper). After searching in vain through the bibliography for some notice of the original specimen, I venture to publish this note in order to draw attention to this most interesting Dinosaur, and in the hope that it may result in the rediscovery of the original, whether in the Milan Museum or in some other collection.

I at one time entertained the idea that the foot under consideration might be referable to the very obscure *Tribelesodon* of Bassani *, placed with doubt among the Ornithosauria, but which, as the author remarks, is rather Dinosaurian in its dentition. But my friend Mr. Smith Woodward, who has recently examined the original of the latter in the Milan Museum, informs me that the bones are undoubtedly hollow; and as the Dinosaurian foot from Esino is typically Stegosaurian, it need not be further compared with *Tribelesodon*.

As the figure shows, we have to deal with a plantigrade form with hoof-shaped ungual phalanges, which agrees in general characters with *Scelidosaurus*, except that the fifth toe is

* Atti Soc. Ital. xxix. 1886, p. 25.

perfectly developed, the digits are more slender, and the distal phalanges broader; so far as the foot is concerned this reptile may be regarded as a more generalized form of the Scelidosauridæ, a view which is in accordance with the older age of the beds whence it was obtained, *Scelidosaurus* being from the Lower Lias.



The specimen is figured above of the natural size. In addition to the perfect foot it shows the distal extremities of the tibia and fibula, which are both distinct from the proximal tarsals. Three tarsals appear to be present in the second row. The third and fourth metatarsals are equal, the second and fifth are slightly shorter, the first measures nearly two thirds the length of the fifth. Phalanges: 2, 3, 4, 5, 3. Distal phalanx hoof-shaped, as broad as long.

The name *Eupodosaurus longobardicus* is proposed for this fossil.

XXXVI.—*Description of Two new Species of* Cicadidæ *from Central America*. By W. L. Distant.

Since I wrote a description of the family Cicadidæ in the Rhynchotal portion of the 'Biologia Centrali-Americana' more specimens have been received, amongst which are the two following undescribed species. The types are in the Godman and Salvin collection.

Fidicina oleacea, sp. n.

♂. Head, pronotum, and mesonotum olivaceous; head with a broad black fascia between the eyes; mesonotum with four dark castaneous obconical spots, the two central ones smallest and darkest. Abdomen above dark castaneous, the tympanal coverings and the fringe to segmental margins dull ochraceous. Body beneath, legs, and opercula pale olivaceous, the tarsi pale ochraceous.

Tegmina and wings pale hyaline, the venation olivaceous and fuscous; tegmina with the costal membrane olivaceous, the postcostal area fuscous.

The opercula are short, barely covering the cavities, their outer margins oblique and slightly sinuate, their apices very broad and moderately convex. The rostrum about reaches the posterior coxæ.

Long. excl. tegm. 20 millim., exp. tegm. 70 millim.

Hab. Mexico, Atoyac in Vera Cruz (*H. H. Smith*).

Tympanoterpes ruatana, sp. n.

♂. Body above dark castaneous; lateral and posterior margins of the pronotum and the mesonotal cruciform elevation olivaceous; eyes ochraceous. Head beneath, sternum, legs, and opercula pale greenish ochraceous; abdomen beneath dark castaneous; anterior tibiæ and tarsi, apices of the intermediate tibiæ and the tarsi, the face, and a marginal fascia between face and eyes castaneous.

Tegmina and wings pale hyaline, the venation olivaceous and fuscous; tegmina with the costal membrane pale olivaceous, the postcostal area fuscous, the transverse veins at the bases of the second and third apical areas slightly infuscated; wings with the base very narrowly and a claval streak fuscous.

The opercula are almost half the length of the abdomen, obliquely and concavely sinuate outwardly, slightly overlapping at their basal inner margins, and thence obliquely divergent to apices, which are rounded. Rostrum about reaching the posterior coxæ.

Long. excl. tegm. 38 millim., exp. tegm. 106 millim.

Hab. Honduras, Ruatan Island (*Gaumer*).

XXXVII.—*Further Note on the Medusæ of St. Andrews Bay (August 1890–May 1891)**. By the Rev. J. H. Crawford, F.L.S., Dundee.

Anthomedusæ.

Among the Ctenophoræ *Beroë* and *Cydippe* were common in August, and remained during the autumn and early winter. As these lessened in numbers *Lesueuria*, absent before, made its appearance. On 21st January there were several *Lesueuriæ* and one *Beroë*. Shortly afterwards all three vanished, and have not yet reappeared.

Tiara octona and *Margelis ramosa* (*Bougainvillia britannica*, Forbes) were fairly numerous during August. A specimen of the former was captured as late as 7th October.

Codonium pulchellum (*Sarsia pulchella*, Forbes) was found only sparingly till towards the close of September, when it was extremely abundant and ripe. After the winter's absence a single young individual was captured in May. The peduncle protruded considerably beyond the velum, and the stomach was greatly distended with food.

Among the more interesting of the Anthomedusæ was *Euphysa aurata*, of which many were brought in during August. This form had the characteristic single abnormally developed tentacle and the three bulbs. In no case were there tentacle rudiments distinguishable from the bulbs. In addition to the scarlet spot on each yellow ocellus, a scarlet ring ran round the umbrellar margin.

A single specimen of *Codonium gemmiferum* (*Sarsia gemmifera*) was captured on 16th August. This was a specially interesting form. The peduncle was much longer than, nearly six times the length of, the umbrella, a condition not mentioned by Forbes. It was beset along its course with spirally arranged buds in different stages of ripeness, and terminated in a bottle-shaped stomach.

Hybocodon seemed to be over for the year, as not a single individual appeared in August. It had been plentiful about June, which seems to be its season. Many specimens were preserved in the laboratory, showing that process of budding at the base of the single tentacle from which it gets its name of humpbacked.

* *Vide* 'Annals,' 1890, v. p. 296.

Leptomedusæ.

The Leptomedusæ were numerous and seem to be the predominant order in the bay, and, indeed, in the North Sea. The chief forms were *Thaumantias hemisphærica* (*inconspicua*, Forbes), *ocellata*, and *Laodice cruciata* (*Thaumantias pilosella*), with marginal cirri and clubs. Both swarmed throughout August, and continued in diminishing numbers till November.

The interesting vesiculate form *Tima Bairdii*, with its characteristic long peduncle, was familiar throughout the autumn and winter, although generally brought in only one at a time. A specimen more than 2 inches in diameter occurred on 21st January; after that it disappeared.

A form evidently allied to *Tima*, but with shorter peduncle, with more numerous tentacles, and with the reproductive organs only on a portion of the canals, was found in great numbers in August, but not later. This is probably the *Irene pellucida* of Hæckel (*Geryonopsis pellucida*, Forbes).

The ocellate *Melicertidium octocostatum* (*Stomobrachium octocostatum*), with its eight canals, was found in August and again (ripe) in January. In each case there was only one individual.

Trachomedusæ.

The Trachomedusæ were unrepresented in August; but *Aglantha digitalis* (*Circe rosea*) made its appearance about the end of September, and was numerous and ripe in January. Not the slightest tinge of the colouring from which it gets its name was noticed in any of the specimens.

Narcomedusæ.

One individual of *Polyxenia cyanostylis* (*Polyxenia Alderi*, Forbes) was brought in on 18th August.

Acraspedæ.

The Tesseridæ were represented by *Lucernaria*, found plentifully in the seaweed in the rock-pools below the laboratory, and the Ephyroniæ (Discomedusæ) by *Cyanea* and *Aurelia*, only too common in the sea and along the shore.

Planulæ.

There were some fine series of *Cyanea planula* in the laboratory in November.

During the last two months (April and May) the bottom-net has yielded a large number of minute forms. Most of these seem to be immature Anthomedusæ and Leptomedusæ, chiefly the latter. The epyræ of Discomedusæ have as yet appeared in surprisingly small numbers.

St. Andrews Marine Laboratory,
1st June, 1891.

XXXVIII.—*Description of a new Species of* Arborophila. By W. R. Ogilvie Grant (Nat. Hist. Mus.).

The Natural-History Museum has for many years possessed a specimen of *Arborophila* which was supposed by Gray to belong to the species *A. orientalis* (*personata*) described by Horsfield from a single adult specimen obtained by him in the province of Blambangan, East Java. The former bird, however, which formed part of the Zoological Society's collection, is marked "Sumatra," and was, in all probability, one of those collected by Raffles in that island. On comparing this specimen with Horsfield's Javan type, it is at once evident that the two birds represent quite distinct species; and I therefore now propose the name *A. sumatrana* for the Sumatran species. On looking up the literature I find that Nicholson ('Ibis,' 1883, p. 256) makes the following remarks:—"The specimens sent by Mr. Forbes [from Sumatra] differ considerably from the type of *Arborophila personata* in the British Museum, being much more of a bluish ash-colour on the fore neck and breast, while the back is much more closely barred with black, and the flanks are much more broadly and distinctly barred with black and white. The different plumages of this species have not been thoroughly worked out; but the Sumatran bird may ultimately prove to be distinct." The synonymy should stand as follows:—

Arborophila sumatrana, sp. n.

Perdix personata, Gray, List of B. pt. v., Gall. p. 59 (1867) [part, Sumatra].
Perdix personata, Gray, Hand-l. B. ii. p. 268. no. 9703 (1870).
Arborophila personata, Nicholson, Ibis, 1883, p. 255.

Resembles *A. orientalis*, but differs in having the lores pale brownish; no white superciliary stripe; the top of the head golden brown tipped with dark brown; the back and upper

parts golden brown fringed and strongly barred with black the chest and breast uniform grey, shading into white on the belly; the side- and flank-feathers with three broad, regular, black, white, and black bands at the extremity; the under tail-coverts white, black towards the base, and the tail-feathers dark brown clouded with golden brown. "Iris dark brown; bill black; legs and feet red; wattle round eye scarlet; skin of neck scarlet (below feathers)." [In female.] (*H. O. Forbes.*)

Total length 11·0 inches, wing 5·8, tail 2·2, tarsus 1·8.

Forbes's specimens were obtained in the forest near Hoedjoeng, at the foot of the Besagi Mountains, 3000 feet, and in the forest at the foot of Kaba volcano, 3000 feet.

XXXIX.—*Note on* Ardeiralla Woodfordi, *Grant*. By W. R. Ogilvie Grant (Nat. Hist. Mus.).

This species was originally described in the 'Proceedings of the Zoological Society,' 1888, p. 202, from three specimens (an adult and nearly adult female and a young male) obtained by Mr. C. M. Woodford at Aola, Guadalcanar, one of the Solomon Islands. These specimens were examined by Count Salvadori during his last visit to London; and I observe that the results of his investigations are published in his 'Aggiunte alla Ornitologia della Papuasia e delle Molucche,' parte terza, p. 207 (1891). While not actually adding *A. Woodfordi* to the synonymy of *A. flavicollis*, he is evidently of opinion that it is only the female of that species. In the Museum collection there are a very large number of specimens of *A. flavicollis* of both sexes, many of them carefully sexed by such collectors as Davison, Oates, and Legge; so that there is no reason to doubt their accuracy. I have again compared the adult female type of *A. Woodfordi* with a series of female specimens of *A. flavicollis*, and cannot imagine how Count Salvadori could think of uniting them, as anything more distinct than the two species before us would be difficult to find; and I have serious doubts as to whether they should not be placed in distinct genera when one compares the very different tarsi and feet. The following is a comparative table, showing the chief points in which they differ:—

	A. Woodfordi, ♀ adult.	*A. flavicollis*, ♀ adult.
Back of the neck, back, and scapulars:	Dark chestnut-rufous.	Ashy brown, slightly glossed.
Rump and upper tail-coverts:	Ashy black, fringed with cinnamon-rufous.	Ashy brown.
Whole of the under surface:	Cinnamon-rufous, becoming more cinnamon and less rufous below the breast. Throat and neck flecked with small dark shaft-spots.	Lower part of the cheeks, sides of the throat, and neck cinnamon. Feathers of the chin, front of throat and neck, and chest dull chestnut, shading into dark grey towards the extremities, and somewhat widely and irregularly margined on one or both webs with white. Breast and underparts blackish grey, edged and fringed with whitish or buff on the belly.
Culmen	3·1.	3·4.
Tarsus	2·7.	2·6.
Middle toe and claw..........	2·1.	2·8.

I think anyone taking the trouble to compare the above characters and measurements will have no further doubt that *A. Woodfordi* is a very distinct bird; the proportion of the middle toe and claw to the tarsus shows this at a glance, for in the Solomon-Island bird the tarsus is much the longer, while in *A. flavicollis* it is somewhat shorter.

Oates, in his 'Birds of Burmah,' ii. p. 255, is no doubt somewhat in error in describing the male and female of *A. flavicollis* as similar in plumage, for the female never has the slate-grey upper and underparts so conspicuous in the adult male.

XL.—*A Contribution to the Knowledge of the Dermal Sense-Organs of the Crustacea.* By Dr. Otto vom Rath *.

I have been engaged for a long time upon comparative studies on the dermal sense-organs of Arthropods, and have already published accounts of my investigations on Myriapods and

* Translated from the 'Zoologischer Anzeiger,' xiv. Jahrg. no. 365, pp. 195–200, and no. 366, pp. 205–214, June 1891.

Insects *; the following paper is intended to give the most important of the results which I have obtained from the Crustacea. In addition to studying our indigenous fresh-water Crustacea † and land Isopods, I availed myself of the opportunity afforded by a sojourn at the Zoological Station at Naples to investigate a large number of marine forms belonging to all the orders and families of which I was able to obtain specimens. My object in so doing was, by comparative studies, both to elucidate the morphology of the several sense-organs, as well as to determine as thoroughly as possible, by means of series of sections, the finer structure of the nerve-end apparatus belonging thereto; for I am of the opinion that an exact knowledge of these relationships is a necessary condition for rational physiological experiments, and that many of the interesting attempts which have been made to determine the function of the sense-organs situated on various parts of the body are not conclusive because sufficient regard has not been paid to other sense-organs of a similar kind.

In the copious literature of the Crustacea we find, as we are all aware, a large number of valuable statements as to individual sense-organs, which, however, in reference to the nerve-end apparatus are not unfrequently contradictory. The reason for these conflicting interpretations may for the most part be found in the fact that very few authors have examined the sense-organs in question by means of sections, and that in examining even the transparent forms confusion may easily take place between the nuclei of the true percipient sense-cells and those of the epidermis-cells. It would be out of place in this short essay to enter into the literature of the subject, yet I would at least recall the important writings of Leydig, Claus, Weismann, Leuckart, La Valette, Hensen, Sars, Hoek, Rougemont, Wrzésniowsky, Gamroth, Haller, Blanc, and Kraepelin. To Leydig the merit is indisputably due of having first described the most important dermal sense-organs in Crustaceans, Myriapods, and Insects.

In the following pages only the most general results of my investigations will be given as briefly as possible: I intend

* O. vom Rath, "Die Sinnesorgane der Antenne und der Unterlippe der Chilognathen," Archiv f. mikr. Anat. 27 Bd. 1886; "Ueber die Hautsinnesorgane der Insecten," Zeitschr. f. wiss. Zoologie, 46 Bd. 3 Heft, 1888.

† Among the higher Crustacea I have paid special attention to *Astacus fluviatilis*, and have examined the whole of its dermal sense-organs; as the hardness of the chitin presents great difficulties to the scalpel, I employed for the purposes of dissection as far as possible specimens which had just moulted and were still fairly soft.

shortly to publish a more detailed account, accompanied by figures.

Owing to the usually extremely hard chitinous body-covering of the Crustacea, a sensory perception, with the exception of sight, can only be conveyed by means of structures composed of hairs. In many cases such sensory hairs are externally in no way distinguishable from ordinary hairs and are characterized as sense-organs only by the sense-cells lying beneath their base; in many instances, however, they have peculiar shapes, and have been described as feathered setæ *, half-feathered setæ, cones, knobs, clubs, plugs, threads, styles, cylinders, tubes ("Fiederborsten, Halbfiederborsten, Kegel, Kolben, Keulen, Zapfen, Fäden, Griffel, Cylinder, Schläuche"), &c. Yet, however different and varied the form of the sensory hairs of the Crustacea, they are nevertheless connected together by a continuous series of transitions. The first antennæ of the Copepods are of especial interest, since we often find upon them placed close together the greatest variety of sensory hairs with the various intermediate forms.

At the spot where any kind of capillary structure, it matters not whether a sensory or an ordinary hair, projects from the cuticle, the latter is pierced by a more or less fine pore-canal. The mode of attachment of the hair is of the greatest functional importance; in the majority of cases the capillary structures rest upon a more or less arched, cupola-shaped, chitinous membrane, which rises from the margin of the pore-canal; this membrane is sometimes soft and thin, so that it gives great mobility to the hair, as is above all characteristic of the auditory hairs. The shaft of the hair is generally in two parts, and consists of a stouter chitinized proximal and a paler thin-walled distal portion, the two being distinctly separated from one another by a slight constriction.

I. On the Occurrence of Dermal Sense-Organs on the Bodies of Crustacea.

In the whole of the Crustacea belonging to the different classes, orders, and families I have discovered sensory hairs on almost all parts of the body. Both the first as well as the

* Feathered setæ are, as is well known, widely distributed among the Crustacea and also occur in the aquatic Dipterous larvæ; I would, however, incidentally remark that feathered setæ are also found in genuine land-animals, *e. g.* on the anterior portion (so-called tongue) of the hypopharynx of *Scutigera*, on the palp-shaped appendages of the maxillæ of *Lithobius*, and on the pedipalpi of male spiders.

second pair of antennæ and their squamæ, the whole of the mouth-parts, and all the pairs of limbs are the bearers of numerous sensory hairs; in a similar way I always found sensory hairs at the end of the tail, on the margin of the last abdominal segment; in rarer instances free sensory hairs are also found on the segments, *e. g.* in *Branchipus*. The sensory hairs of the mouth-parts and legs have hardly been noticed at all by authors, and I know of no precise statements in literature with reference either to their arrangement and shape or to the finer histological structure of the nerve-end apparatus; the sensory hairs of the antennæ, on the other hand, have been described by a number of writers.

Before passing on to speak of the various sensory hairs, I would remind the reader that the whole of the jointed appendages of the Crustacea, with the exception of the first antennæ, are reducible to the typical biramose limb, and in the following pages I shall employ the convenient expressions—protopodite (shaft), exopodite (outer branch), and endopodite (inner branch).

a. *Sense-Organs of the Antennæ.*

The antennule, or first antenna, is the bearer of the most important sensory hairs, since upon it are found both the so-called olfactory tubes ("Riechschläuche") and also, at least in the Decapods, the auditory organs; besides these we find on the most widely different regions of this first antenna sensory hairs of various shapes, which are regarded as tactile organs. Tactile hairs, which run to a sharp point and are not feathered, are found distributed with a certain amount of regularity in the immediate neighbourhood of the olfactory tubes, and act to a certain extent as protecting setæ. The number and arrangement, as well as the outward form and size, of the olfactory tubes are extremely varied and characteristic in the orders and families, and to a large extent even in the different species. In certain cases a number of them are found on the terminal joint only of the first antenna, *e. g.* in *Idothea*; frequently they are collected in bundles on several joints, *e. g.* in *Astacus*; but it is not unusual to find a single structure of the kind only on several joints, *e. g.* in *Caprella*.

It is worthy of note that in the male sex the size and number of these organs is much more considerable than in the female, and it was shown by Weismann * for *Leptodora* and

* Weismann, "Ueber Bau- und Lebenserscheinungen von *Leptodora hyalina*," Zeitschr. für wiss. Zool. 24 Bd., 1874.

by Claus * for *Nebalia* and *Phronima* that it is not until the animal arrives at sexual maturity that they attain their full number. In a similar way it has long been known that in blind Crustacea the number and size of the olfactory tubes is more considerable than in their allies with full visual power, *e. g.* in *Asellus cavaticus* and *Gammarus puteanus*. The mode of attachment of the olfactory tubes to the cuticle is of such a kind as to exclude any great degree of mobility for the hair, and we can therefore hardly suppose them to be auditory organs. Whether the usually bluntly rounded distal end of the structures we are discussing is closed by a delicate membrane, as Claus insists, or is open, as stated by Leydig, is difficult to determine. The hair appeared to me to be closed in many cases and open in others; moreover, these extremely delicate structures are often damaged at the tip. I would on no account advise treating these organs with liquor potassæ, since I have often convinced myself, in the case of Myriapods, Insects, and Crustacea, that after boiling unmistakably closed olfactory cones or tubes in a weak solution of potash a distinct opening became visible, since the delicate closing membrane had simply disappeared. I have, however, been able to determine by a series of experiments that in Crustacea the closing membranes of the olfactory tubes are so thin as to present no obstacle to delicate sensation, while fluids are able to penetrate them very easily, and to come into direct contact with the nerve-end apparatus. Into a saturated aqueous solution of *bleu de Lyon*, or methylene blue, I put a large number of small living Crustacea, e. g. *Asellus*, *Gammarus*, and different species of Cladocera, and then fished out specimens at different intervals, some after one hour, others later. A stay of three to four days in these dyes does not injure an *Asellus* in the least; on the contrary, on being washed in fresh water and examined under the microscope these Isopods appear perfectly lively. In the animals upon which I experimented the tips of the olfactory tubes had invariably become coloured first; the dye then gradually spread as far as the base of the hair, and after a longer period had elapsed the nerve-end apparatus was also found to have become stained. I made a similar experiment upon larger Crustacea, such as *Astacus*, by cutting off from the living animal the first antenna at its base and laying it in the solution. Staining at once began to take place at the tips of the olfactory tubes, and then penetrated slowly downwards. As a matter of course,

* Claus, "Ueber den Organismus der Nebaliiden und die systematische Stellung der Leptostraca," Arbeiten aus d. Zoolog. Institut der Univ. Wien, 1889; "Der Organismus der Phronimiden," *ibid.* 1879.

before commencing my experiments I was careful to ascertain that all the olfactory tubes were intact.

With the auditory organ situated in the basal joint of the first antennæ of the Decapods I shall deal very shortly, and refer the reader to Hensen's * detailed description. This author distinguishes otolith-hairs, free hairs in the auditory sac, and free hairs situated upon the surface of the antennæ. Characteristic for all auditory hairs is their mode of attachment, in that the shaft, which is always feathered, stands upon an extremely delicate cupola- or dome-shaped membrane, in consequence of which the hair is able to swing to and fro with the greatest ease, and can be set in motion by waves of sound. According to Hensen, "the auditory hairs stand upon a pore-canal, the walls of which develop on one side a larger or smaller thickening, the tooth. All hairs exhibit at one portion of their proximal end a peculiar process, the ligula, to which the nerve is attached." Contrary to Hensen, in examining my extensive material I not unfrequently met with feathered hairs, occupying an intermediate position between typical, freely mobile, auditory hairs, and feathered, stiff, unmistakably tactile hairs, resting upon a strongly chitinized cupola-shaped membrane, so that it was a moot point whether such transitional forms were to be regarded as auditory or tactile hairs.

Among tactile hairs, always ending in a sharp point, there are found upon the first antennæ unfeathered, half-feathered, completely feathered, and toothed sensory hairs.

In the first antenna of *Nebalia* there spring from a four-jointed shaft two branches, of which the one is flagelliform and bears the typical olfactory tubes, while the other is expanded into a squamiform plate, the margin of which is beset with a large number of long, fine, sharply pointed sensory hairs, which are not plumose, but rather finely denticulate.

Incidentally I would just allude to the fact that upon the antennæ of certain Amphipods peculiar hairs have been found, the so-called "*calceoli*." These shoe-like appendages, the physiological importance of which is still obscure, are by no means confined, as was formerly supposed, to the flagellum of the lower antennæ of the male, but occur, as has been shown by later investigations, in some forms in the female sex also, and, moreover, on both pairs of antennæ.

The sensory hairs of the *second antenna* are of far less

* Hensen, "Studien über das Gehörorgan der Decapoden," Zeitschr. für wiss. Zool. 13 Bd., 1863.

importance than those of the first *. Typical olfactory tubes have been discovered upon the second antennæ, which are also designated tactile antennæ, only in *Nebalia* and *Diastylis*, through the researches of Claus.

Tactile hairs, however, occur in abundance upon the second antennæ, and may exhibit great differences in number, size, and shape, while here and there they constitute forms which are transitional to the olfactory tubes. To this category also belong the cylinders or clubs of the lower antennæ of *Gammarus puteanus* (Leydig). Whether the plugs which are found at the tip of the large (second) antennæ of the woodlice have the value of a more highly differentiated sense-organ, or whether they likewise are tactile in function, has not been decided. It is also not unusual to find upon the second antennæ feathered hairs which are easily movable and stand freely upon the surface, and which, judging by the analogy of their general appearance, might be regarded as auditory. To the sensory hairs of the second antennæ likewise belong the feathered hairs standing on the edges of the squamæ in the higher Malacostraca; I determined the presence of the group of sense-cells belonging to each of these hairs in the case of *Mysis*, *Siriella*, *Squilla*, *Palæmon*, and *Astacus*.

b. *Sense-Organs of the Mouth-parts.*

As I have found in Myriapods and Insects sense-organs in the buccal cavity and upon the mouth-parts which, according to their position and form, were best interpreted as organs of taste, it was a natural idea to search for such sense-organs in the Crustacea also in the region of the mouth-parts. I was able to determine that in all the species I examined, belonging to the most widely different orders and families, the mouth-parts always bear a large number of sensory hairs of various shapes, generally feathered and pointed at the tip, which I would regard as tactile bristles; I was never able to find hairs, however, which could be compared with the olfactory tubes of the antennæ, or which, in consequence of their general appearance, could be interpreted as gustatory or olfactory organs. In the cases where the mandible carries a palp this organ exhibits at the tip a large sensory field beset with many hairs, *e. g.* in *Astacus*; in both pairs of maxillæ of all Crustacea sensory hairs are closely packed on the exo- and endopodites as well as on the lobes. In the case of *Astacus* I further

* I may remind the reader that the second antennæ may be atrophied into a stump, *e. g.* in *Phronima*.

found that, in a similar way, the first three thoracic appendages also, which are termed maxillipedes or accessory maxillæ, are richly provided with sensory hairs on the exopodites, endopodites, and lobes (first maxillipede). Owing to the agreement shown by these discoveries I considered it *à priori* probable that all the pairs of appendages belonging to thorax and abdomen would have their sensory hairs.

c. *Sense-organs of the Thoracic and Abdominal Appendages (Pleopoda).*

The presence of sensory hairs upon the whole of the extremities I determined successively in the Phyllopoda (*Branchipus* and *Apus*), Cladocera (*Daphnia, Sida, Moina*), Copepoda (*Diaptomus, Cyclops, Calanus*), Amphipoda (*Phronima, Hyperia*), Isopoda (*Anilocra, Cymothoa, Idothea*), Schizopoda (*Siriella, Mysis*), and Decapoda (*Astacus* and *Palæmon*). In the case of biramose appendages, sense-organs are found upon the exopodite as well as the endopodite. In the Cirripedia (e. g. *Lepas*) I found that the whole of the hairs upon the cirriform limbs were sensory. In the Arthrostraca and Thoracostraca the abdomen consists, as we know, of seven segments, of which the first six usually bear pairs of limbs (pleopoda), while the telson, or seventh segment, is always apodous. Even the telson is provided with sensory hairs. I cannot here enter upon a closer description of the sensory hairs of the several appendages in the different families and species. The auditory organs situated in the endopodite of the last pair of pleopoda, the so-called tail, of the Schizopods *Siriella* and *Mysis* are provided with otolithic hairs, possessing the characteristic peculiarities described above in the case of the auditory hairs of the first antennæ. In the Schizopods we also find free auditory hairs upon the surface of the tail.

d. *Free Sense-organs upon the Segments.*

Under this head I merely make passing allusion to the fact that in a few rare cases free sensory hairs have also been described as existing upon the somites, and have been held to be tactile in function. Weismann found feathered tactile setæ standing in pairs upon the dorsal surface of the fourth abdominal segment of *Leptodora*, and Claus alludes to similar free tactile bristles upon the somites of *Branchipus*.

II. Histological Structure of the Nerve-end Apparatus of the Sensory Hairs of Crustacea.

The histology of the nerve-end apparatus of the various sensory hairs, whether olfactory tubes or tactile hairs (smooth, half-feathered, completely feathered, or toothed), is essentially the same, and corresponds most minutely with what I have previously described for Myriapods and Insects. My interpretation of the finer structure of the nerve-end apparatus of the sensory hairs of Arthropods differs somewhat from the statements of other authors.

In the Crustacea, beneath the base of each capilliform structure serving a sensory function, there lies a group of cells which is connected with a nerve; these cells are termed a ganglion by authors; but since they are manifestly the percipient epithelial cells, I prefer to term them sense-cells, without, however, intending thereby to insist on a strict physiological distinction between ganglion- and sense-cells. In very rare cases only, *e. g.* in the whole of the sensory hairs of the cirriform feet of *Lepas*, I found beneath the hair only a single bipolar sense-cell, of relatively large size and elongate in form, with a roundish nucleus which considerably exceeded the nuclei of the cells of the hypodermis in size. According to the usually accepted view, the nerve which is connected with the ganglion-cells is supposed to traverse the entire length of the ganglion and then enter the sensory hair. I have been able in a very large number of cases, *e. g.* in the olfactory tubes of *Astacus* *, to convince myself with absolute certainty of the fact that the nerve in no way passes through the group of sense-cells, so that the sense-cells are attached to the nerve-fibrils much as the grapes in a bunch; on the contrary, the nerve splits up beneath the group of sense-cells and gives off a fibril to each cell. In the anterior or distal region of the group of sense-cells I then distinctly saw the way in which the protoplasmic prolongations of the various cells unite into a finely streaked bundle, the *terminal cord*, which actually enters the hair, while its fibrillate nature can often be distinctly recognized right to the tip of that structure. Strictly speaking therefore the sensory hair does not contain a true nerve, but rather the united prolongations of sensitive epithelial cells; it follows therefore that we can scarcely speak of a true axis-cylinder or axis-fibre. The

* An olfactory tube of *Astacus*, with the nerve-end apparatus belonging thereto, has already been described and figured by me in my previous publication (Archiv f. mikr. Anat. 27 Bd., 1886).

lumen of the sensory hair, however, is by no means exclusively occupied by the terminal cord; I observed in many cases, and with especial distinctness in the olfactory tubes, that the hypodermis-cells send distinct processes into the hair; the cells which do this are those which form the matrix of the hair. The number of sense-cells belonging to each sensory hair varies very much: in the case of the Decapods I was always able to count a large number of them, but in the Phyllopods and Cladocera only a few. The groups of sense-cells are sometimes rounder, sometimes more elongate or linear in shape. The nuclei of these cells are usually round and possess a corresponding network of chromatin-fibres; they are readily distinguishable from the more elongate and always darker-coloured nuclei of the hypodermis. It is only shortly after ecdysis (as is seen especially clearly in *Astacus*) that the difference in external appearance between the nuclei of the hypodermis-cells and those of the sense-cells is small. The group of sense-cells often lies a very long way from the hypodermis and the sensory hair, and the terminal cord is then of considerable length *, as, for instance, in the first antennæ of the Caridinæ and Brachyura. Each group of sense-cells is surrounded by a sheath, which consists of flat cells with flattened nuclei, and appears as a continuous prolongation of the neurilemma of the nerves. It can usually be distinctly seen that this sheath also surrounds the terminal cord. I believe that the cells of the sheath do not essentially differ from those of the hypodermis. When the groups of sense-cells are collected in greater numbers near one another, and lie at some little distance from the sensory hairs, we always detect between the terminal cords elongate dark-coloured nuclei, which belong to elongated hypodermis-cells. From these cells it is not always easy to distinguish those of the above-mentioned sheath of the terminal cord. If the sensory hairs, as is often the case, are united into a bundle, or stand close together in larger numbers upon a common sensory field, the groups of sensory cells belonging to the separate hairs may be compressed into a compact mass. Even then, however, the separate elongated groups or bands of sense-cells can be distinguished with tolerable clearness within the apparently single ganglion, and we observe between them the flat nuclei belonging to their sheaths of connective tissue. The terminal cords, too, are approximated to one another, and between them lie flat nuclei, which belong partly to the

* In the Insects the group of sense-cells is usually found in the neighbourhood of the hair, and is even frequently situated within the hypodermis.

connective-tissue sheaths of the terminal cords, and partly to the intermediate hypodermis-cells, but in no case justify the assumption of the existence of a second anterior ganglion. I would remind the reader that I have already proved, in connexion with the Myriapods and Insects, that in all cases in which authors, *e. g.* Sazepin, have described two ganglia lying one behind the other, *e. g.* in the antennæ of the Chilognatha and the Wasp, in reality only a single group of sense-cells exists. In a similar way I convinced myself in the case of the Crustacea that in those instances in which it was stated by authors that the nerve-end apparatus consisted of two ganglia lying one behind the other (first antenna of the Daphnids and Phyllopods according to Leydig, first antenna of *Leptodora* according to Weismann), or that one ganglion was divided into two parts connected by nervous matter (large or second antenna of the Woodlice according to Leydig *), in reality only one ganglion, that is a single group of sense-cells, is to be found; and that hypodermis-cells have been mistaken for a second distal ganglion. Moreover we may get the false appearance of two groups of sense-cells lying one behind the other, owing to the fact that tactile hairs also are usually found in the immediate neighbourhood of the olfactory tubes, and that, even in sections, the group of sense-cells belonging to the former are always closer to the hypodermis than those of the latter. We find the most interesting structural conditions of the nerve-end apparatus among the Entomostraca. I have already remarked that the whole of the sensory hairs of the cirriform feet of *Lepas* show only a single large sense-cell beneath their base, while hitherto in all other cases I have always found a group of sense-cells beneath the sensory hair †.

* Leydig, "Ueber Amphipoden und Isopoden," Zeitschr. f. wiss. Zool. 30 Bd. Suppl., 1878; "*Artemia salina* und *Branchipus stagnalis*," ibid. 3 Bd., 1851; 'Naturgeschichte der Daphniden,' 1860; "Geruchs- und Gehörorgane der Krebse und Insecten," Archiv f. Anat. u. Phys. 1855; "Die Hautsinnesorgane der Arthropoden," Zool. Anz. 9 Jhg., nos. 222 and 223, 1886.

† Among Insects the instances in which only a single sense-cell belongs to a hair are also by far the most unusual, and, in addition to the cases described and figured by me, occur chiefly in the sense-organs of the halteres of Diptera, as has recently been shown by Weinland. In his paper on the balancers (halteres) of Diptera (Zeitschr. f. wiss. Zool. 51 Bd., i. Heft) Weinland, among other things, describes the histology of the sense-organs belonging to the halteres, and states that, in connexion with each of these different sense-organs, a bipolar ganglion-cell is always found. Weinland further says:—"That several ganglion-cells send out from among them only a single nerve-ending, as has been stated by vom Rath to be the more usual occurrence in Insects, is at any rate not the case in the nerve-end apparatus of the halteres; Künckel's view is in this

As regards the sense-organs of the Phyllopods, e. g. *Branchipus*, the views of authors are divided. According to Leydig (*loc. cit.*) and Spangenberg *, two ganglion-cells, lying one behind the other, belong to each sensory hair; Claus † was able to distinguish only one ganglion-cell; in connexion with the sensory hairs of *Branchipus* I always counted from three to four cells, and from four to five beneath those of *Apus*. With the sensory hairs of both these Phyllopods I shall subsequently deal at greater length. Among the Cladocera the number of sense-cells belonging to each sensory hair is also tolerably small.

As regards the histological structure of the nerve-end apparatus of the auditory organs, this in no way differs from the description which I have given above. I am unable to confirm the statements of authors (*e. g.* Hensen, *loc. cit.*), who ascribe only a single ganglion-cell to each auditory hair; on the contrary, I always found beneath the base of each auditory hair of *Astacus*, *Siriella*, and *Mysis* a distinct group of sense-cells, with terminal cords reaching to the tip of the hair.

I would here just mention in passing that behind the groups of sense-cells in the Crustacea I have never found those peculiar large cells of glandular appearance, such as I have described as *companion cells* (" Begleitzellen ") in the case of the sense-organs of Myriapods and many Insects; nevertheless in the neighbourhood of the Crustacean dermal sense-organs there occur, with a certain degree of regularity, on both pairs of antennæ, as well as on the whole of the limbs, irregular groups of typical gland-cells, which are particularly noticeable in the Amphipoda and Isopoda.

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instance perfectly accurate." The latter remark is liable to be misunderstood. I therefore lay stress upon the fact that Künckel is certainly in error in holding that in Insects invariably only a single ganglion-cell belongs to all sensory hairs. There are isolated cases, it is true, in which only a single sense-cell is found in connexion with each sensory hair, and I may refer the reader to my statements (Zeitschr. f. wiss. Zool. 46 Bd. 3, pp. 416-419) and figures (figs. 3 *b*, 10, 16, 32). At that time I had not included the sense-organs of the halteres within the scope of my investigations; since then I have convinced myself by means of series of sections that it is actually true that only a single large bipolar ganglion-cell belongs to each sense-organ.

* Spangenberg, " Zur Kenntnis von *Branchipus stagnalis*," Zeitschr. f. wiss. Zool. 25 Bd. Suppl., 1875.

† Claus, " Untersuchungen über die Organisation und Entwicklung von *Branchipus* und *Artemia*," Arbeiten aus d. Zool. Institute d. Univ. Wien, 1885.

III. The Physiological Import of the Dermal Sense-organs.

In discussing the physiological function of the dermal sense-organs of Crustacea we must as far as possible guard against anthropomorphic conceptions. It is advisable to define the sensations by means of their physical or chemical causes. The perception of an image originating in the eye we term sight, the perception of the waves of sound, hearing, while the perception of the different kinds of resistance to pressure and many other mechanical influences we call touch. In the case of aquatic Crustacea it appears to be a matter of choice whether we speak of the perception of chemical substances dissolved in the water as smell or taste. Crustacea possess no sense-organs within the buccal cavity which, by virtue of their position, we could explain as organs of taste, and those sense-organs situated outside the buccal cavity (upon the antennæ) which are adapted to the perception of chemical substances dissolved in water may serve equally well for the detection and taste of food-matter as for the perception of any other stimulus depending upon chemical influence. I therefore see no reason, in the case of Crustacea which live in water, for drawing a distinction between taste and smell. We should exercise the greater caution in wishing to recognize in Crustacea the same sensations which are experienced by human beings, since the structure of the sense-organs is fundamentally different in the two cases, while even the biological purposes which the sense-organs serve can only coincide to a limited degree. It is very possible that the Crustacea possess senses entirely unknown to us, as, for instance, a sensation which is affected by the amount of oxygen in the water*. It is perfectly certain that the degree of acuteness as well as the extent of the sensations, that is the limits within which perceptions are possible for the various senses, vary extraordinarily in different animals. The eye of a bird of prey and the olfactory organ of a dog far surpass in acuteness of perception the respective sense-organs in the human being. It is well known that many Insects perceive rays of light and waves of sound which have no effect upon our own sense-organs.

We will now discuss the question as to how far we may draw conclusions from the morphological structure of the sense-organs as to the physiological functions of the senses.

* The Crustacea possess sense-organs the function of which is veiled in obscurity, *e. g.* the frontal organ of the Entomostraca.

The nerve-end apparatus is so similar in structure in the different sense-organs that, as it seems to me, it cannot be made use of for this purpose; we have therefore to consider in the first place the form and mode of attachment of the hairs, as well as their number and position. Those capilliform structures which do not terminate in a sharp point, and which at their distal, usually paler, and thin-walled end, as is shown by the experiments detailed above, permit the entrance of chemical substances dissolved in water, will at once, with some degree of probability, be explained as olfactory or gustatory organs. Those plumose hairs which rest upon an unusually delicate domed membrane, and which are therefore very easily set swinging, are regarded as auditory organs. Those sensory hairs which in all probability serve neither the olfactory nor auditory function are designated tactile setæ. In drawing these distinctions it is by no means maintained that the functions specified are so sharply delimited from one another, and that possibly the same hair may not serve in several of the above-mentioned capacities at once. Let us now enquire how the various organs are distributed upon the body.

The olfactory organs (olfactory tubes) are situated exclusively upon the first antennæ in all the Crustacea which we have examined, with the exception of *Nebalia* and *Diastylis*, in which they occur upon the second antennæ also. In my opinion these organs probably serve in the first place to scent out food and the opposite sex; in the case of the aquatic forms they would have the general function of testing the chemical conditions of the water. In exclusively terrestrial Crustacea, *e. g.* the Woodlice, they would in all probability enable the animal to find out the constitution of the atmosphere, and in this sense might be designated olfactory organs. In discussing the olfactory tubes we must also allude to the fact that they are more powerfully developed in the blind Crustacea than in their nearest allies possessing eyes; and the interesting circumstance that these organs are usually more numerous and larger in the sexually mature male than in the female is also worthy of notice. The theory has often been advanced by authors that the females at the period of maturity of the ova emit a glandular secretion, which is detected by the male by means of his olfactory organs. In the case of the freshwater Copepods, Vosseler * states it as a fact that "the females are discovered and fertilized by the males at night, and even by day, the male must possess other

* Julius Vosseler, 'Die freilebenden Copepoden Württembergs,' Dissertation. Stuttgart, 1886.

means of assistance in addition to his feebly developed eyes, to enable him to distinguish the sexes in pools where the water is often quite turbid." An auditory function on the part of the organs of scent or smell is negatived by the circumstance that, on the one hand, auditory organs could hardly be of special use to the Crustacea in the search for food and in scenting out the other sex, and, on the other, that the mode of attachment of these capilliform structures is of such a kind that they could not well be set swinging and perceive sound-waves.

Into a discussion of the question of the power of hearing in the Crustacea I will not enter here. As regards the higher forms, the Decapods and Schizopods, we have the minute investigations and careful experiments of Hensen (*loc. cit.*), which prove that these higher Malacostraca at any rate possess a very fine sense of hearing. Moreover, it has recently been rendered very probable by the interesting experiments of Delage * that the auditory organs of the Decapods and Schizopods at the same time serve yet another function, in providing for the orientation of the position of the body and the regulation of the equilibrium. Whether and to what extent the Arthrostraca and Entomostraca are able to hear, that is to perceive waves of sound, is, according to our present knowledge of the subject, still very uncertain.

All the sensory hairs which we are not inclined to regard as olfactory or auditory are termed simply tactile organs. To this category belong certain sensory hairs of the first antennæ, and most of those upon the second antenna and its squame; in addition to these all the sensory hairs of the mouth-parts, legs, and caudal appendages, and, finally, all the free sensory setæ upon the somites. Just as the form and arrangement of these sensory hairs, which we call tactile organs, present the greatest variety in the different families and species, while not unfrequently several tactile hairs completely different in shape are found close together upon a certain part of the body in the same animal, so must we make a distinction between the functions of these capilliform structures, and, in addition to coarser and finer tactile sensations, assume the existence of a large number of the most widely different gradations, which our perceptions are certainly unable to appreciate.

Zoological Institute of the University of
Freiburg i. B., April 1891.

* Delage, "Sur une fonction nouvelle des otocystes comme organes d'orientation locomotrice," Archives d. zool. expérim. 1887 (2) t. v. p. 1.

XLI.—*Evidence of the Occurrence of Pterosaurians and Plesiosaurians in the Cretaceous of Brazil, discovered by Joseph Mawson, Esq., F.G.S.* By A. Smith Woodward, F.G.S.*

Three years ago the writer contributed to the 'Annals' † a series of brief notes on some vertebrate fossils from the Province of Bahia, Brazil, collected and presented to the British Museum by Joseph Mawson, Esq., F.G.S., of the Brazilian Central Railway. To the continued investigations of the same generous donor the Museum is now indebted for three additional series of specimens, partly referable to the types already discovered, and partly adding to the known fauna. All are more or less fragmentary, but the fossils in the latter category are of interest as foreshadowing some of the discoveries that may eventually be expected from the Brazilian Cretaceous formation; and three of the bones capable of ordinal determination extend so considerably the known range of two extinct Reptilian groups, that they seem worthy of being placed on record at once. Two of these bones are examples of the articular end of a large Pterosaurian quadrate; the third fossil is a Plesiosaurian propodial bone. Each of the three specimens was met with in the Cretaceous shale on the coast near Bahia, from which Mr. Mawson has already obtained so many other vertebrate remains.

I. Pterosaurian Quadrate. (Fig. 2.)

The best example of the Pterosaurian quadrate bone is shown of three halves the natural size from the postero-internal aspect in the accompanying fig. 2, and the drawings above and below (figs. 2 *a*, *b*) represent the fractured surface and the articular face respectively. The element pertains to the left side and exhibits the large internal facette (*f*) for the articulation of the hinder pterygoid lamina; while the postero-external margin of the bone is acutely angulated. The ginglymoid articular end displays its characteristic obliquity, and the broken transverse section shows no trace of an internal cavity.

The fossil thus described seems to be most nearly paralleled, both in form and size, by a quadrate bone from the Kim-

* Read before Section C, British Association, Cardiff, 1891.

† Ann. & Mag. Nat. Hist. [6] vol. ii. (1888) pp. 132–136.

meridge Clay of Dorsetshire provisionally assigned by Mr. Lydekker to *Rhamphorhynchus Manseli* *. The second specimen is also of the same character, but evidently pertains to a slightly larger animal. At present, however, the evidence

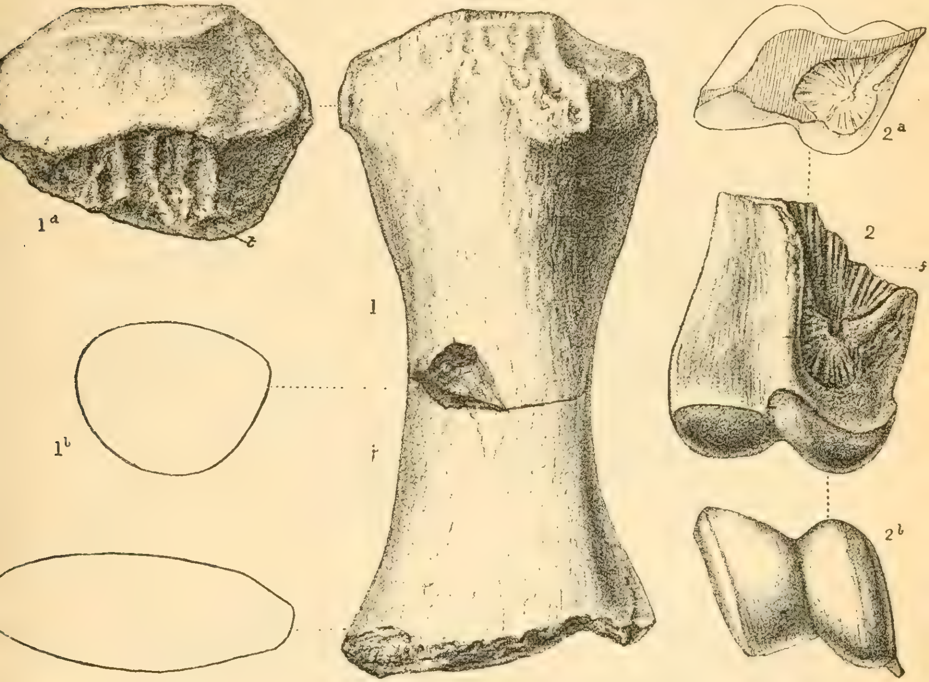

Fig. 1.—Dorsal aspect of left propodial bone (? humerus) of a Plesiosaurian, two thirds nat. size. 1 *a*. View of proximal end, with tuberosity (*t*). 1 *b*, *c*. Transverse sections.

Fig. 2.—Articular portion of left quadrate bone of a Pterosaurian, postero-internal aspect, $\frac{3}{2}$ nat. size. 2 *a*. Upper view (fractured surface). 2 *b*. Articular end.

Both specimens from the Upper Cretaceous of Bahia, Brazil; in the British Museum.

is insufficient for the determination either of the genus or species; and for this purpose further discoveries must be awaited.

One of the specimens was found between Plataforma and

* Quart. Journ. Geol. Soc. vol. xlvii. (1891) p. 41, pl. v. figs. 3, 4.

Itacaranha, and the other was obtained either from this beach or from Pedra Furada Bay (Montserrat). It is interesting to add that in the same formation and localities Mr. Mawson has detected fragments of delicate limb-bones, which he considers may also have belonged to a Pterosaurian; and it is hoped that before long an examination of some of these will lead to a more precise determination of the animal.

II. Plesiosaurian Propodium. (Fig. 1.)

The fossil readily recognizable as a Plesiosaurian propodial bone (humerus or femur) has lost the expanded distal extremity, but is otherwise well preserved. It is shown of two thirds the natural size, from the dorsal aspect, in fig. 1, and a view of the proximal end, a mesial transverse section, and a distal transverse section are given respectively in figs. 1 *a*–*c*. The proximal end is very robust and coarsely rugose, with much greater breadth than thickness, and an only slightly differentiated tuberosity (*t*). The epiphyses are so firmly anchylosed with the shaft as not to be distinguishable; and the shaft itself is smooth and rounded, exhibiting only one longitudinal angulation in its middle portion on the inner side.

The bone thus described may probably be regarded as the left humerus of a typical marine Plesiosaurian; but beyond that suggestion it seems as yet impossible to proceed.

As already remarked, the interest of these new fossils from Bahia consists chiefly in their extending the known geographical range of two great extinct orders of reptiles. So far as the writer is aware, the only Mesozoic Reptilian remains hitherto recorded from South America are: (i.) a Plesiosaurian vertebra from the supposed Cretaceous of San Vicente, near Concepcion, Chili *; (ii.) Crocodilian vertebræ from Juntas, in the valley of the Copiapo, Argentine Republic †; (iii.) numerous parts of a Cretaceous crocodile, *Hyposaurus derbianus*, from Pernambuco and Bahia, Brazil ‡; and (iv.) large Dinosaurian bones from the Cretaceous of Limay and

* *Plesiosaurus chilensis*, Gay, Hist. fis. y polit. Chile, Zool. vol. ii. (1848) p. 133; *Cimoliosaurus chilensis*, Lydekker, Cat. Foss. Rept. B. M. pt. ii. (1889) p. 222.

† H. Burmeister, Abhandl. naturf. Ges. Halle, vol. vi. p. 122, pl. i. figs. 1–3.

‡ E. D. Cope, Proc. Amer. Phil. Soc. vol. xxiii. (1886) p. 15; R. Lydekker, Cat. Foss. Rept. B. M. pt. i. (1888) p. 91. Figures of teeth and a vertebral centrum are also given by S. Allport, Quart. Journ. Geol. Soc. vol. xvi. (1860) pls. xvi., xvii.

Neuquen, Patagonia*. Mr. Mawson's discovery of the Pterodactyl seems to be the first of the kind in the Southern Hemisphere; that of the Plesiosaur adds another important locality to the known distribution of an order that has an equally wide geographical range in both Hemispheres.

XLII.—*Notes on African Mollusca.* By Edgar A. Smith.

I. *Unionidæ* of South Africa.

At present nine species of this family have been described from the southern extremity of the African continent, namely seven so-called species of the genus *Unio* and two species of *Mutela*. Five, if not six, of the forms of *Unio* really belong, I believe, to one and the same species. They have been separated on account of slight differences of form and sculpture, which, when a large series of specimens is examined, prove to be very unreliable and inconstant. Intermediate forms both in respect of outline and sculpture are met with, showing that the separation of these various forms cannot be maintained. The synonymy is as follows:—

1. *Unio caffer*, Krauss.

1848. *Unio caffer*, Krauss, Südafr. Moll. p. 18, pl. i. fig. 14.
1856. *Unio caffer*, Küster, Conch.-Cab. p. 143, pl. xlii. figs. 2, 3.
1866. *Unio caffer*, Sowerby, Conch. Icon. pl. xli. fig. 226.
1850. *Unio Verreauxianus*, Lea, Proc. Acad. Nat. Sci. Philad. vol. viii. p. 94.
1858. *Unio Verreauxianus*, id. Journ. Acad. Nat. Sci. Philad. vol. iii. p. 301, pl. xxvii. fig. 16.
1868. *Unio Verreauxianus*, Sowerby, *l. c.* pl. lxix. fig. 352.
1850. *Unio africanus*, Lea, Proc. Acad. Nat. Sci. Philad. vol. viii. p. 94.
1858. *Unio africanus*, id. Journal, vol. iii. p. 300, pl. xxvii. fig. 15.
1865. *Unio africanus*, Sowerby, *l. c.* pl. xxii. fig. 100 (wrong locality given).
1864. *Unio natalensis*, Lea, Proc. Ac. N. Sci. Phil. vol. xxii. p. 113.
1866. *Unio natalensis*, id. Journal, vol. vi. p. 59, pl. xx. fig. 57.
1868. *Unio natalensis*, Sowerby, *l. c.* pl. lxxi. fig. 362.
1885. *Unio vaalensis*, Chaper, Bull. Soc. Zool. France, vol. x. p. 480, pl. xi. figs. 1–3.

Hab. Rivers of Natal and Cape Colony.

This species has the surface ornamented with concentric

* F. P. Moreno, "Le Musée de La Plata" (in 'Revista de Museo de la Plata,' vol. i., 1890), p. 18.

striæ, which are more or less distinct, and frequently it exhibits more or less of wrinkling or corrugation at the upper part of the valves towards the umbones, which are always to some extent eroded. It is well known that in this genus the amount of wrinkling of the surface is very variable, and therefore cannot be regarded as a reliable specific character.

In the type figured by Krauss the shell is described as "concentrice ruguloso-striata," and no special reference is made by him to corrugation near the beaks. The apices of his specimens being considerably eroded, it is probable that this feature was for the most part obliterated. The form delineated by Lea under the name of *U. Verreauxianus* appears to be precisely that of the type, and although "numerous small undulations at the tip" of the beaks are mentioned by him, no trace of them is discoverable in his figures, and therefore we may assume that they were very insignificant.

His *U. africanus*, from the same locality as *Verreauxianus*, differs from it merely in having the surface smoother, the transverse striæ being finer. In form and the character of the hinge they are quite alike.

The variety named *U. natalensis* by Lea, which is the same as *U. vaalensis* of Chaper, is peculiar on account of having the upper part of the valves much more strongly wrinkled than the type or the variety *africanus*, but it agrees with them in general form and the character of the hinge.

The two obsolete lines radiating backwards from the umbones, referred to by Krauss, exist in all the varieties and specimens examined. The colour of the nacre is as variable as the form and sculpture. It is "pallide carnea" in the type, "salmonis colore tincta" in *Verreauxianus*, *africana*, and *natalensis*, and "teintée en jaune clair" in *vaalensis*, especially towards the umbones. Finally, there are specimens in the National Collection which are olive-brown beneath the beaks, almost white towards the front part of the ventral margin, and beautifully iridescent at the posterior end.

The difference in form is very considerable, even in shells belonging to the same variety; for example, two specimens of the strongly wrinkled form (*natalensis*) have the following measurements:—

	Length.	Height.	Diameter.
a	67	40	23
b	59½	29	19

From the above figures it is noticeable that specimen *a* is much broader in proportion than *b*. The outline of the two shells is quite different, but the sculpture is the same.

Specimen *a* is oval, more pointed behind than in front, having the ventral and dorsal margins about equally curved. On the other hand, example *b* is elongate, with the lower margin quite straight along the middle, and, the valves being somewhat pinched or compressed at that part, it has an almost incurved appearance.

2. *Unio Verreauxi* (Charpentier), Küster.

Unio Verreauxi, Charpentier, MSS., Küster, Conch.-Cab. p. 150, pl. xliii. fig. 6.

Hab. Soutenthal Valley, Cape of Good Hope.

I have not as yet seen a specimen sufficiently like the figure of this species to determine whether it is really distinct or not from *U. caffer*, although there is every probability that it will eventually prove to be merely a large broad form of it. It most resembles specimen *a* of the variety *natalensis* already described, but differs from it in being a little broader posteriorly and in having the hinge-line straighter and more raised at the hinder end. The fine lines mentioned by Küster as radiating from the umbones downwards are also traceable more or less in most specimens of all the varieties of *U. caffer* when regarded in certain lights.

3. *Unio kunenensis*, Mousson.

Unio kunenensis, Mousson, Journ. de Conch. 1887, p. 300, pl. xii. fig. 10.

Hab. A tributary of the Kunene or Cunune River, North Ovambo or Ovampo, South-west Africa.

This species, although found rather far north, may be classed with the South-African species in contradistinction to those found in the north, west, east, and central parts of the continent.

It is quite different from the species already discussed, having the surface for the most part ornamented with angular wrinkling or corrugation.

4. *Mutela Wahlbergi*, Krauss.

Iridina Wahlbergi, Krauss, Südafr. Moll. p. 19, pl. ii. fig. 1.
Spatha Wahlbergi, Clessin, Conch.-Cab. ed. 2 (*Anodonta* &c.), p. 187, pl. lxiii. fig. 1.
Spatha natalensis, Lea, Proc. Acad. Nat. Sci. Philad. 1864, p. 113; id. Journal, vol. vi. p. 64, pl. xx. fig. 58; Clessin, *l. c.* p. 189, pl. lxii. figs. 7, 8.

Hab. Monkey River, a branch of the Limpopo (*Krauss*); Umpingave River, Natal (*Lea*); Natal (*Brit. Mus.*).

I cannot discover any good reasons for separating Lea's *Spatha natalensis* from this species, and it is remarkable that, in his account of it, he did not refer to *Wahlbergi*. The form, sculpture, epidermis, and muscular scars are precisely the same; but the interior of *Wahlbergi* is described as whitish for the most part, but pale flesh-colour towards the middle. On the other hand, the nacre of *natalensis* is described as purple. This difference of colour, however, is not of any material importance, for it is well known to be a very variable character in Unionidæ.

II. *Demoulia.*

This genus was founded by Gray for the reception of *Buccinum retusum* of Lamarck and a new species from Senegal, namely *D. pulchra*. The latter, the type of which, from Gray's collection, is now in the British Museum, is identical with *D. pinguis* described by A. Adams some thirteen years later.

D. retusa and another species, *D. abbreviata*, have spiral sculpture only, and in this respect they are peculiar. But this is not sufficient to found a genus upon. If we admit differences of sculpture to be of generic importance, we could make half a dozen or more genera out of *Nassa* itself.

On the other hand, *D. pulchra*, which, in form and general aspect, agrees with the two species mentioned, differs from them in having the spiral striæ crossed by longitudinal lines, thus producing a fine reticulation. It will thus be seen that the character of spiral sulci and ridges is inconstant.

In the genus *Nassa* the form and surface-ornamentation is notably variable, and examples may be selected, e. g. *N. glans* and *N. thersites*, which are far more dissimilar in both respects than the species of *Demoulia* are from many forms of *Nassa*. *Nassa Cumingii*, for instance, has quite the shape of *Demoulia*, and really differs only in having the transverse ridges beaded instead of smooth. Moreover, *D. ringens* has very similar granular sculpture; and if we separate *D. abbreviata* and *D. retusa* on account of their having smooth transverse sculpture, then we must remove *ringens* to another group.

Gray * considered that the "velvety periostracum" afforded a character which would separate it from *Nassa*. Difference of epidermis, however, is not a generic character, for how many species of *Conus*, *Pectunculus*, and other genera

* Ann. Nat. Hist. 1838, vol. i. p. 29.

there are which are clothed with periostraca of entirely different kinds.

The animal of *Demoulia* has hitherto been unknown excepting the operculum, described by H. and A. Adams *. However, through the liberality of Mr. J. H. Ponsonby, who has lately presented to the British Museum a specimen of *D. retusa* containing the animal, I am able to give the following particulars.

The sole of the foot (in alcohol) is uniform light brown. The head and body are also light brown, irregularly speckled with black. The foot is short, squarish in front, with a double edge, rounded behind, and *apparently* without prolongations as in *Nassa*; but it is possible that, being contracted in spirit, they are not visible, or may have got broken off. The head is compressed; the tentacles are short, acuminate, with the eyes on prominences about halfway up the outer side. The siphonal fold of the mantle is darkish at the end and moderately short. The radula † is Nassoid; the lateral tooth on each side is oblique, bicuspid, the outer cusp being largest, with the acute tip curved inwards and the inner cusp more slender and also slightly incurved. The central tooth is arcuate, as broad or broader than the laterals, and armed with nine slender, acute, subequal denticles.

The figure illustrating the dentition of *Nassa variabilis* in Troschel's Gebiss d. Schneck. vol. ii. pl. viii. fig. 19, affords a very good idea of that of the present species. The laterals, however, of the *Nassa* have the inner cusp shorter and less slender and the denticles on the central tooth are more unequal in length.

The most remarkable character about *D. retusa* is the want of an operculum.

From the above remarks it will be seen that there really exist no good characters to separate *Demoulia* from *Nassa*. There is nothing in the formation of the shell which distinguishes it, and the structure of the animal is exactly the same in both, and the fact that the operculum in one species (*pulchra*) is present, and wanting in another (*retusa*), shows that it is not an essential generic character.

This genus was originally described by Gray under the name *Demoulia*, and there is no valid reason why the spelling of this word should be changed. Gray himself appears to have been the first to make an alteration, and in the 'Proceedings of the Zoological Society' for 1847, p. 140, he

* Gen. Moll. vol. i. p. 115, pl. xii. fig. 6 *a*.

† I have to thank my friend Mr. B. B. Woodward for kindly mounting this with his accustomed skill.

rendered it *Desmoulea*, a spelling copied by A. Adams *, Tryon †, Fischer ‡, Chenu §, Kobelt ||, &c. At the time, however, he gave no reason for the change, and quoted "*Desmoulea*" as if it were the original spelling.

Agassiz ¶, Philippi **, Hermannsen ††, and Dunker ‡‡ have all hinted that this genus might have some association with the name of M. Charles Desmoulins, and Woodward, in his 'Manual' (p. 112), has rendered it "*Desmoulinsia*," regarding it as a synonym of *Nassa*. However, as Gray is somewhat notorious for the number of "nonsense names" which he has given to numerous genera, I have no doubt this is a name of that description; moreover, in the same paper he created the genus *Drillia*, which apparently is also meaningless.

Philippi, that most excellent and accurate writer, employs in his 'Handbuch der Conchyliologie,' p. 150, the original term "*Demoulia*;" and this rendering I certainly think should be maintained, a view also held by Crosse §§.

The species which have been referred to this genus are all figured in Tryon's 'Manual of Conchology,' vol. iv. pl. xviii. figs. 361–370, and in Reeve's 'Conchologia Iconica,' vol. viii., *Nassa*, pl. xxix. figs. 190–196. They are as follows:—

1. *Demoulia pulchra*, Gray.

Demoulia abbreviata, A. Ad.
Demoulia ponderosa, Reeve, = *crassa*, A. Ad.

Hab. Sierra Leone and Senegal.

The locality "Japan" for *crassa* has never been confirmed.

2. *Demoulia retusa* (Lamk.).

Hab. Cape Colony.

3. *Demoulia Tryoni*, Crosse.

Hab. ——?

This species is united by Tryon with *D. retusa*, but it appears to me very different in many respects.

* Proc. Zool. Soc. 1851, p. 113; Gen. Moll. vol. i. p. 115.
† Man. Moll. vol. iv. p. 65.
‡ Man. Conch. p. 634.
§ Man. de Conch. p. 161.
|| Illustr. Conchylienbuch. p. 46.
¶ Nomencl. Zool. Moll. p. 29.
** Handbuch Conch. p. 150.
†† Indicis gen. Malacoz. prim. vol. i. p. 377.
‡‡ Index Moll. mar. jap. p. 34.
§§ Journ. de Conch. 1871, p. 71.

4. *Demoulia abbreviata* (Gmelin).

Hab. Cape Colony.

5. *Demoulia japonica*, A. Ad.

Hab. Japan.

6. *Demoulia ringens*, A. Ad.

Hab. —— ?

7. *Demoulia pyramidalis*, A. Ad.

Hab. Port Elizabeth, South Africa (*Marrat and Sowerby*). The locality "Japan" originally assigned to this species still wants confirmation.

The first five of the preceding species form a group which may be of equal value with the numerous sections or subgenera into which the genus *Nassa* has been divided, and to it the name *Demoulia* may be assigned, and the last two, being of different form, will fall into other groups.

III. *Neothauma.*

Through the energy of Capt. E. Coode Hore the British Museum has obtained two specimens of this Tanganyikan genus preserved in spirit. The animal may be thus described:—

Foot short, as broad as long, front margin double-edged, a little wider than behind, of a slaty-grey colour beneath and at the sides, also beneath the operculum when removed. Head, tentacles, neck-lappets, and front margin of the mantle of the same tint. Tentacles short, broad, horizontally compressed at the base, tip pointed and apparently not produced much beyond the eyes, situated on slight lateral prominences. Left neck-lappet moderate; right very large, folded, forming a distinct branchial siphon. The upper margin is reflexed under the right tentacle and produced under the rostrum as far as the mouth, forming as it were a third lappet. Rostrum shortish, blunt. The radula, kindly mounted and examined by my colleague Mr. B. B. Woodward, has the formula 3. 1. 3, and is of the same type as that of *Viviparus*.

From the above description it will be seen that the animal

of *Neothauma* agrees in general structure with that of *Viviparus.* The tentacles certainly are very short and compressed, but that is merely of specific value.

The genus *Neothauma* was proposed on account of the aperture being somewhat effuse anteriorly and of the broad sinus in the outer lip, and at the time it was conjectured that these characters indicated some corresponding anatomical peculiarities. The right neck-lappet certainly is rather large, and doubtless the object of the labral sinus is to accommodate this siphonal structure. Beyond this there appears to be no reason for separating this form generically from *Viviparus.*

There is a species described by Prof. E. von Martens from China—"*Paludina* (*Melantho*) *auriculata*"—which feebly exhibits both an anterior effusion and a lateral emargination, and some of the specimens also have a peripherial angle like *Neothauma* (*vide* Novit. Conch. vol. iv. pl. cxxxv. figs. 4–6). "*Paludina angulata*, Lea," a North-American form now placed in the genus *Tylotoma*, has the aperture prolonged at the base, but the outer lip exhibits only a very slight trace of a median sinus. After careful consideration I now regard the extreme development of a labral sinus in *Neothauma* merely as a specific character, and not of generic importance. It will therefore pass into the synonymy of the genus *Viviparus.*

XLIII.—*Sessile-eyed Crustaceans.*

By the Rev. T. R. R. Stebbing, M.A.

[Plates XV. & XVI.]

A new Species of Talorchestia.

Of this widely distributed genus no European species appears to have been hitherto noticed. The name of the genus refers to its close connexion with the genera *Talitrus* and *Orchestia*, it being in a manner compounded of both, since the males of *Talorchestia* are *Orchestiæ*, while the females are *Talitri.* The distinction of the three genera can therefore only be regarded as conventional; yet it cannot well be relinquished, on account of the large number of species that have to be dealt with. It is attended by the special inconvenience that in this group animals of which only one sex is known cannot have their genus definitely determined. Thus "*Orchestia* (*Talitrus*) *pugettensis*," Dana, and "*Talorchestia? africana*," Sp. Bate, are still uncertain, both having been described from females only.

It may here be mentioned that *Talorchestia diemenensis*, Haswell, 1880, a Tasmanian species, ought to be referred to *Orchestia*, since both the figure and the description show that the first gnathopod in the female is not simple but subchelate, that is to say it has the precise character which separates *Orchestia* from *Talorchestia*.

The new species, *Talorchestia brito*, has the head truncate in front, the peræon only moderately widened, the pleon narrow, with the hind corners of the third segment squared.

The eyes are large, irregularly rounded, and conspicuously white, with the black pigment more or less discernible beneath.

The Male.—The upper antennæ scarcely reach the end of the penultimate joint of the peduncle of the lower; the three joints of the peduncle are nearly equal in length, or the middle joint is slightly the longest; the flagellum of seven joints is less than half the length of the peduncle. In the lower antennæ the third joint has a lobed terminal margin; the fourth joint is not very much shorter than the long fifth joint; the flagellum has thirty or more stout but short articulations.

The first gnathopods: The side-plates are narrow, somewhat folded, directed forwards. The first free joint is narrow at the neck, with the front margin straight, the hinder convex; the fourth joint or wrist is not much shorter than the first, distally widened, near the distal end of the hind margin having a pellucid bubble-like process; as this projects among various spines, the impression produced at first sight was that of an actual bubble of water entangled among the spines. The hand is much shorter than the wrist, more spiny, and having a similar but shallower bubble-like process, which, by offering something for the finger to close against, renders it subchelate. The finger is short, with a small upright spine on the inner margin and a small rounded projection at the base of the nail.

The second gnathopods: The side-plates are large, rhomboidal, with a slight emargination at the upper part of the hind margin. The long first joint widens abruptly from the narrow neck, its width again diminishing towards the distal end; the oblong third joint is scarcely so long as the second; the fourth or wrist is quite insignificant in size and almost coalescent with the hand, which is of great length and breadth, an irregular oval, abruptly narrowed at the insertion of the long, powerful, and distally bent finger. The palm margin is fringed with numerous spines, its edge only microscopically crenulate; the closed finger hugs it closely, except

proximally, where there is a little gap left, and distally, where the point of the finger overlaps it.

The Female.—The upper antennæ are smaller than in the male, the middle joint of the peduncle not longer than either of the other two joints; the flagellum has five joints. In the lower antennæ the last joint of the peduncle is considerably longer than the preceding and is more strongly spined than in the male; the flagellum in the specimen examined had twenty-two joints.

The first gnathopods differ little from those of the male except in the complete absence of the pellucid processes on the wrist and hand, the latter being simple instead of subchelate; as in the male its hind margin is fringed with stout round-headed spines; the subterminal hair in these and many of the other spines on this limb is so thick that it produces the appearance of a cleft head to the spine.

The second gnathopods are in strong contrast to those of the male, being almost membranaceous. The first joint is narrow at the neck, thence widening out into an oval plate rather more than twice as long as it is broad; this serves as a protection for the delicate terminal joints, which, when not in use, are twisted round to lie upon it; the second and third joints are tolerably muscular; the wrist is rather inflated, almost transparent, widest near the distal end; the equally transparent hand is rather longer, with numerous spinules near the hind margin, the distal end rounded, projecting considerably beyond the minute triangular finger, which is inserted at the extremity of the straight front margin, and has its inner edge overlapped by a row of spinules on the hand.

Both Sexes.—The upper lip has the free margin finely furred, evenly rounded. The mandibles have the cutting-edge divided into five teeth, of which the terminal one is double; the inner plate has four teeth, in a single series on the left mandible, but on the right distinguished into two that are large and prominent and two that are small and insignificant; there are five plumose spines on the left and four on the right mandible; the molar tubercle is short and stout. The first maxillæ have the broad outer plate surmounted by nine spines, most of them denticulate; low down on its convex outer margin is the minute (so-called) palp, two-jointed; the inner plate is narrow, ending in two feathered setæ. The maxillipeds, as indeed the other mouth-organs, closely resemble those which have been described for *Talorchestia tumida*, Thomson, in the Trans. Zool. Soc. vol. xii. pt. vi., 1887.

The triturating organs of the stomach are fringed each with thirty spines.

The branchial vesicles are narrow and twisted. All the peræopods are strongly spined. The first pair are considerably longer than the second and third, and considerably shorter than the fourth and fifth. The side-plates of the first and second are large and rhomboidal, of the third and fourth broad and bilobed, those of the fifth being semioval. In the first and second pairs the first joint is nearly parallel-sided; in the other three pairs it is oval, most regularly so in the fourth, being in the third much smaller and almost circular and in the fifth rather wider and a little more squared than in the fourth. In the first, fourth, and fifth pairs the finger has the inner margin nearly straight. In the second pair the finger is very short, abruptly narrowed on the inner margin halfway towards the nail; in the third pair it is equally short, rather stouter, with the inner margin less abruptly narrowed and the outer minutely furred. In all the pairs there is a setule near the base of the little nail on the inner margin, and on the outer a pair of microscopic processes of oval form.

The pleopods have long membranaceous peduncles, carrying two or three rows of small spines. The two coupling-spines are very short, single-toothed. The rami have fifteen or sixteen joints.

The first uropods have the peduncles longer than the slightly unequal strongly spined rami; the second have shorter peduncles, but slightly longer than the rami, of which the inner is a little the shorter. In the third pair the single ramus is much narrower, but not shorter than the peduncle.

The telson is broadest near the base, narrowest at the truncate end, on either side of which is a small group of spinules, another group being placed near the middle of the convex lateral margins.

The length of a good-sized male, not including the antennæ, is four fifths of an inch.

The colour is a very distinguishing character while the animal is alive. The ground-colour is yellowish white, here and there barred with deeper yellow, bordered along the side-plates and across the head with a beautiful purple, bands of which also sometimes extend across the back of the pleon. The appendages of the peræon and pleon and the telson are for the most part pellucid.

The specific name is chosen to mark the discovery of a representative of a genus now for the first time included in the fauna of Great Britain.

The species was obtained in abundance during the months of July and August of the present year (1891) on Woolacombe and Saunton Sands, in North Devon. It burrows in the sand after the fashion of *Talitrus locusta*, and occupies a zone of the shore immediately below that in which the *Talitri* are commonly found. Bright as its colouring is when observed near to the eye, upon the sand it is very easily lost sight of. By the lateral extension of the fourth peræopods it maintains an upright gait, although there is no dilatation of the middle joints in either the fourth peræopods or the fifth. When pursued its ingenuity in availing itself of the smallest shelter is considerable; its hoppings also are energetic, but they cease sooner than those of the *Talitri*, and the capture is consequently rather easier. It swims in an upright position, and when tired turns over, and so sinks gently to the bottom. In a finger-glass half full of sea-water several specimens lived in apparent content for four days. Some *Talitri* in similar circumstances did the same. At the end of that time they all sickened from a surfeit of boiled lobster supplied by way of experiment; and from want of time to attend to their possible recovery, euthanasia was administered through the medium of methylated spirit. On another occasion a large male *Talorchestia* was detected holding a young companion in its claw and feeding upon the still quivering little victim.

The following table may be useful as explaining the fine distinctions which separate four very closely related genera:—

	Gn. 1, ♂.	Gn. 2, ♂.	Gn. 1, ♀.	Gn. 2, ♀.
Talitrus, Latreille....	Simple.	Feebly chelate.	Simple.	Feebly chelate.
Orchestia, Leach ...	Subchelate.	Strongly subchelate.	Subchelate.	Feebly chelate.
Talorchestia, Dana ..	Subchelate.	Strongly subchelate.	Simple.	Feebly chelate.
Orchestoidea, Nicolet..	Simple.	Strongly subchelate.	Simple.	Feebly chelate.

Thus in the male sex *Talorchestia* cannot be distinguished from *Orchestia*, and in the female neither *Talorchestia* nor *Orchestoidea* can be distinguished from *Talitrus*.

A new Species of Leptognathia.

Leptognathia Lilljeborgi, sp. n., appears to approach *Leptognathia longiremis* (Lilljeborg) more nearly than any other species of the genus, but at the same time to be very clearly distinguished from it by the antennæ, gnathopods, and uropods.

The body is very slender, more than eight times as long as broad, parallel-sided except at the two extremities. The

carapace, that is, the head with the first peræon-segment, is nearly twice as long as the greatest breadth; the front part is narrowed. The first free segment of the peræon is shorter than the rest, the next four being subequal, and the last only a little longer than the first. The fifth segment of the pleon is rather longer than any of the preceding four. The last segment is rather longer than the fourth and fifth together, and is obtusely rounded at the slightly narrowed extremity.

No eyes are perceptible. The upper antennæ (of the female) are shorter than the carapace; the first joint much longer than the next two together, the third a little longer than the second, the fourth quite rudimentary. The lower antennæ are much smaller than and implanted considerably behind the upper pair; the antepenultimate joint is much the longest and curved in lateral view.

The upper lip is dome-shaped. The mandibles have a finely serrate cutting-edge combined with a couple of teeth, which are stronger on the left than on the right mandible. The latter is shown in the figure interlocked between the two teeth of the left mandible. As they are seen from below the right mandible is on the left hand.

The first maxilla consists of a long narrow lobe, curved at the extremity, where it carries five setæ, with a setule on the outer margin a little below the apex; the exopod was not observed, but was doubtless of the usual form.

The maxillipeds have four strong setæ on the terminal joint and two smaller ones on the inner margin of the long penultimate joint. The central plate appeared to be undivided, but was not clearly observed.

The first gnathopods have the first free joint massive, larger than any of the others, widest near the base, as wide as long; the second joint is absent or coalesced; the third is small and triangular, carrying a single setule; the wrist is more than once and a half as long as broad; the hand proximally is fully as broad as the wrist, the outer margin very convex, its apex projecting much beyond the base of the finger, and there set with several tubercles; on the inner side it makes an abrupt bend at a very short distance from the wrist, forming a broad thumb ending in a nail-like process, and carrying two setæ on the inner margin and three or four together with some flattened tubercles on the border facing the finger. The finger is irregularly tubercled on the outer margin and smooth on the inner, its tip closing within the unguicular process of the hand.

The second gnathopods have the first free joint long, slender, and bent; the third, fourth, and fifth joints are sub-

equal, together longer than the first; the finger is about two thirds as long as the fifth joint, the slender nail being longer than the base.

The first and second peræopods have the joints shorter and less slender, the first not curved. The hand has a serrate spine on the inner margin near the finger, the preceding joint having a similar spine on the outer apex and a longer spine on the inner. In the last three pairs of peræopods the first joint is a little more dilated, the hand has serrate margins, and there is a group of serrate spines at the apex both of this and of the preceding joint; the finger has a minute instead of an elongate nail.

The marsupium is composed of eight plates.

All five pairs of pleopods are well developed in the female, each of the oval rami carrying about thirteen setæ, which did not appear to be plumose.

The uropods have the peduncle about twice as long as broad. The inner ramus consists of two long joints, the first a little longer than the peduncle and the second a little longer than the first; the first carries three setæ at the apex, the second five or six, and one on the inner margin a little way above the apex. The outer ramus is narrow, equal in length to the peduncle, the first joint having an apical seta on the outer margin, the second, which is slightly shorter, having two setæ on the apex.

The length of the animal is about one tenth of an inch.

Three or four specimens were obtained in August 1890 in the sands at Lee and Woolacombe, North Devon. The species is named in compliment to Professor Lilljeborg, who published an important work on the Tanaidæ in 1864.

The species *Leptognathia laticaudata*, G. O. Sars, was taken in June this year in the Clyde at Kames Bay, while I was dredging in company with Mr. David Robertson, F.L.S. This species is, it seems, new to the fauna of Great Britain.

EXPLANATION OF THE PLATES.

Plate XV.

Talorchestia brito, sp. n. *gn.* 1, ♂, first gnathopod of male; *gn.* 2, ♂, second gnathopod of male; *gn.* 1, ♀, first gnathopod of female; *gn.* 2, ♀, second gnathopod of female; *prps.* 1, 2, 3, 4, last two joints of the first, second, third, and fourth peræopods respectively; *ur.* 3, third uropod; T, telson.

Plate XVI.

Leptognathia Lilljeborgi, sp. n. Dorsal view of the animal, the natural size indicated by the line above. *a. s.*, upper antenna, three terminal joints; *a. i.*, lower antenna; *l. s.*, upper lip; *m. m.*, parts

of the mandibles; *mx.* 1, part of first maxilla; *mxp.*, maxillipeds; *gn.* 1, first gnathopod, omitting the large basal joint; *gn.* 1, B, first gnathopod from another specimen, finger and part of hand; *gn.* 2, second gnathopod; *prp.* 5, fifth peræopod; *plp.* 4, fourth pleopod; *ur.*, uropod; T, telson.

MISCELLANEOUS.

Note on Parmacellus gracilis, *Gray.*

In 1855 (Cat. Pulm. Brit. Mus. part 1, p. 64) there appeared the description of a slug under the name of *Parmacellus gracilis.* This species, which was based on a specimen purchased with the label "*Parmacella Olivieri*," in the collection of the British Museum, has never since been recognized. The locality was unknown.

Last year, while examining the slugs in the British Museum, I found a specimen of *Ibycus fissidens* (=*sikkimensis*) with the label "*Parmacella.* 43. 3. 31. 33," which was entered in the accession-book as "*Parmacella Olivieri*, purchased at Stevens'." I described this slug in Ann. & Mag. Nat. Hist., Jan. 1891, p. 106, as *I. sikkimensis*,=*fissidens*; but it never occurred to me at the time that it was the original of *Parmacellus gracilis.* Having now compared my notes with the original description, it is evident that these are the same thing. The history of the specimen, with its label, together with the general agreement of the described characters, is convincing.

The synonymy will accordingly stand:—

Ibycus gracilis (Gray, 1855).
=*I. fissidens* (Heyn., 1862).
=*I. sikkimensis* (G.-Aust.).

T. D. A. Cockerell.

Institute of Jamaica, Kingston, Jamaica,
August 18, 1891.

On the Development of Sponges (Spongilla fluviatilis). By M. Yves Delage.

1. *Formation of the Ectoderm.*—M. Goette, of Strasbourg, in his work on the development of the Freshwater Sponge, states that the larval ectoderm is thrown off, and that the permanent external membrane is formed by the superficial layer of the internal mesodermic mass. All previous authors, on the contrary, affirm with Ganin that the larval ectoderm is transformed into the permanent one, and recently this view has been re-established by M. Maas, of Berlin, who describes in detail the phenomena of the transformation.

I showed last year * that in *Esperella*, a genus of siliceous marine sponges, there exist among the ciliated cells of the larval ectoderm large non-ciliated cells, which pass to the surface after the larva becomes fixed, and form the permanent ecto-

* 'Comptes Rendus,' séance of March 24, 1890.

derm, while the ciliated cells lose their cilia and travel into the interior of the body, to take part in the histogeny of the internal organs.

In *Spongilla* there are no strange elements between the ciliated cells; the processes nevertheless take place as in *Esperella.* Beneath the ciliated cells there lies a discontinuous layer of large rounded cells, which, after the fixture of the larva, travel to the exterior and form the permanent ectoderm. The only difference between *Esperella* and *Spongilla* is that in the latter the true ectoderm is entirely internal, separated from the outside by a continuous layer of ciliated cells.

2. *Capture of the Ciliated Cells.*—What happens to the ciliated cells in the interior? A phenomenon here takes place which is extremely singular and without parallel in the known processes of embryogeny.

The central nucleus of the larva is formed in greater part of large cells, easy to recognize owing to their large and perfectly round nucleus, provided with a fine nucleolus, and in consequence of their frequently containing vacuoles and a few coarse granulations. These cells in the free-swimming larva have a regularly rounded outline. After the larva becomes fixed the ciliated cells, having lost their cilia, shrunk, and become round, occupy a peripheral zone immediately underlying the ectoderm, which now comes into existence. The large cells in the interior become amœboid and protrude towards the former ciliated cells large and very active pseudopodia, which capture them one by one. As soon as a cell is captured, the contracting pseudopodium incorporates it, and the large cell regains its rounded outline at this point, while in other directions other pseudopodia arise to continue the chase.

These phenomena take place rapidly. Usually the capture is completed in half an hour or an hour. The larva then rests for about twenty-four hours without change. It appears spread out, encircled by a fine extension-membrane, and completely crammed with the large cells, which, now that they are in repose, are perfectly round, and exhibit around their proper nucleus, which lies in the centre, a large number of little nuclei, the origin of which we have just seen. It is these nuclei which were taken by Goette and Maas for vitelline granules. I have always observed, contrary to the assertions of the latter author, that they stain red in solutions of carmine with an affinity for nuclei, and that Lyons blue respects them so far as to substitute itself for the carmine in the nucleolus belonging to the large cell before staining these supposed vitelline granules. Methylene green also stains them more deeply than the central nucleus.

3. *Formation of the Ampullæ.*—After an interval of from twenty-four to thirty-six hours the captured cells begin to become active. They increase in size, travel gradually towards the periphery of the large cell, and finally emerge from it and become free again. Some arrange themselves as a lining-membrane for the canals, while the rest become grouped in hollow spherical masses and acquire first a flagellum and then a collar for the formation of the ampullæ. The

supposed vibratile ampullæ, figured by M. Maas in a larva still having all its peripheral cylindrical cells in place, are nothing but common rounded lacunæ; their limiting cells have no cilia and in no way arise from the layer which clothes the cavity of the larva.

The pores and the oscula are distinct from their origin, the latter being upon the middle convex portion of the young sponge, while the former, which are much more numerous, are situated at the boundary between the convex body and the peripheral membrane, or upon this membrane itself.

In the foregoing paragraphs I have indicated only the general course of the embryogeny. I shall explain shortly how these phenomena are complicated by the division of cells and other details.

In *Aplysilla*, which is a fibrous sponge, the formation of the ectoderm and of the ampullæ is similar, almost to the details, to that which has just been described for *Spongilla*. Just as in *Spongilla*, the mesodermic amœboid cell is cast off at the periphery and remains in the parenchyma outside the ampullæ, while in *Esperella* it remains for a long time in the interior of the ampulla, of the formation of which it has been the centre.

These new observations will be understood as modifying in a certain degree the interpretation which I put forward last year on the subject of the formation of the ampullæ in this latter type.

To conclude: the ectoderm arises at the expense of cells primitively internal; the ciliated cells take no part in its formation; they pass into the interior of the body, are captured by mesodermic amœboid cells, and later on regain their liberty and take part in the formation of the ampullæ and canals. This capture of the ciliated cells is, after all, nothing but a phenomenon of phagocytosis, which is incomplete in that it is temporary. This term is the more applicable, since a certain number appear to be really digested. It is probable that at the moment when they lose their cilia these cells undergo a temporary diminution of their vitality, and that the amœboid cells, working on their own account, capture them as they would food-matter, but do not succeed in digesting them. It is very curious to see an incident of this kind becoming a normal phenomenon of the development. There is something in it which recalls the phenomena of histolysis described by Kovalevsky in the Insects, but with this great difference, that here the elements incorporated by the phagocytes are utilized in the subsequent histogeny directly, and not as simple nutritive matter.—*Comptes Rendus*, tome cxiii. no. 5 (3 août, 1891), pp. 267–269.

On the Development of the Blastodermic Layers in Isopod Crustacea (Porcellio scaber). By M. Louis Roule.

In a former note I have explained the origin of the blastoderm in the embryos of *Porcellio*. The germinal disk, containing the nucleus of the oosperm, envelops the nutritive yolk, borrowing therefrom the necessary protoplasm for this extension; its nucleus divides, by the usual process of karyokinesis, into several segments, which again undergo division; and the whole is thus converted into cells, which rapidly increase in number. On the completion of this

stage the nutritive yolk is surrounded by a simple layer of blastodermal elements.

The blastoderm then proliferates in several regions and upon the inner surface. One of these regions, which occupies the future median and ventral line of the embryo, extends from the anterior to the posterior extremity of the ovum; a projecting band arises, which advances into the yolk, and rapidly divides into two parallel and adjoining zones. This parallel band will give origin to the nervous centres; it is interrupted beneath the anterior pole of the body, at a spot where the stomodœumm appears; divided in this way, its anterior portion constitutes the rudiment of the brain and its posterior section that of the ventral cord.

At the moment when the first indications of the nervous centres are seen, the blastodermal elements multiply in two regions situate upon the sides of the embryo, a little behind the cerebral rudiment and on both sides of the median line. Each of these tracts soon exhibits, beneath the blastoderm, a layer of cells which extends in three directions—above, below, and behind. When the extension in the two former directions has arrived at a certain point it stops, and the layer of cells buries itself horizontally, by its upper and lower edges, in the nutritive yolk, upon which it acts like a punch. This new extension ceases when the two edges reach the median line; they then bend inwards, and, continuing to grow, approach one another until they meet and unite. Each layer has thus formed a tube, which occupies the greater portion of the corresponding half of the body of the embryo, and the cavity of which, closing behind, contains the nutritive yolk which it has imprisoned during its development. These two tubes are the rudiment of the organ erroneously termed the Crustacean *liver*; this organ, bounded by the endoderm of which we have just traced the mode of formation, should be regarded as the enteron of these animals; its functions, moreover, notably in the case of the lower Crustacea, are nutritive rather than glandular.

Apart from the liver, the remainder of the alimentary canal is derived from two opposite blastodermic invaginations, one of which is inferior and somewhat ventral, the other superior and slightly dorsal. The two depressions sink into the yolk in order to meet one another; they first touch, then fuse, and the region of their juncture unites with the liver at two points. The anterior or stomodeal invagination produces the œsophagus and stomach, while the posterior or proctodeal gives rise to the intestine.

The mesoderm arises while these different processes are in progress. This layer is produced by the elements of the blastoderm; the majority of these divide into segments, the external of which continues to form part of the blastodermal layer, while the internal penetrates into the yolk. The latter divides in its turn into several other cells, and, the same thing happening for the whole of the blastoderm, the aggregate of these elements constitutes the mesoderm. The principal zones of proliferation are situated on the ventral face of the body, at the base of the limbs; they are consequently two in number, situated one on each side of the median

line. The mesodermic cells are nourished at the expense of the nutritive yolk which surrounds them; they develop in the typical mesenchymatous fashion, and the cavities which arise between them to form the vascular canals are at their commencement little confluent lacunæ of irregular outline. None of these cavities can be considered as corresponding, whether in its mode of development or its origin, to the mesodermal zoonites of the Annelids.

The blastoderm provides for these different proliferations without losing the appearance of a simple epithelial layer surrounding the nutritive yolk; it retains this condition after the rudiments of the mesoderm with those of the endoderm have arisen at its expense and separated from it; it then represents the ectoderm.—*Comptes Rendus*, tome cxii. no. 25 (22 juin, 1891), pp. 1460–1462.

On the Development of the Mesoderm of Crustacea, and on that of the Organs derived from it. By M. Louis Roule.

I have shown in a former note (June 1891) *, on the basis of the embryonic stages of *Porcellio scaber*, Latr., the process of the formation of the endoderm; the layer is produced from a pair of rudiments arising from two symmetrical regions of the anterior portion of the blastoderm. The mesoderm also has the same origin, with this difference, however, that the mode of development is much less regular.

My observations have been conducted upon *Porcellio scaber* and *Palæmon serratus*, Fabr. At the moment when the cells of the blastoderm are multiplying in the median ventral line for the production of the nervous centres, and on the sides of the anterior extremity of the body to give rise to the rudiments of the endoderm, two new zones of proliferation appear, one on either side of the ventral nervous band. The different regions of each zone are not perfectly similar; some, separated by equal distances, are thicker than others, and raise up the blastoderm which covers them and from which they have arisen; these elevated spots are the rudiments of the limbs. The blastoderm left at the periphery will become the ectoderm of these appendages; the central mass of cells represents the mesoderm; the cells of this mass become transformed into muscle-fibres in the way which I have described in a previous note ('Comptes Rendus,' January 1891).

An analogous multiplication of cells takes place throughout the entire blastoderm, except in those regions which furnish the rudiments of the nerve-centres and of the endoderm, only the process is less vigorous; its effect is to produce the elements which penetrate into the yolk lying beneath the blastoderm, and destroy it little by little by feeding upon the nutritive materials which it contains. These elements correspond to the *vitelline cells* of authors, as to which opinions have been so numerous and so contradictory; they all arise from the blastoderm alone, and are destined to form the mesoderm of the body, without there being any differences of development between them or ground for distinguishing between a primary and secondary mesoderm. Receiving their proper situation

* *Vide suprà.*

in the body of the embryo, these cells are placed between the blastoderm and the endoderm; they multiply by karyokinesis, just like those of the limbs.

The middle layer is now constituted. The elements arise from the blastoderm, which, after having provided for their genesis, persists as the ectoderm on the surface of the body. Moreover, its cells are distributed throughout the entire embryo between the blastoderm and endoderm, are immersed in the deutoplasm, which they devour little by little, and are accumulated in large numbers in the rudiments of the feet.

The mesoderm will next develop in the mesenchymatous fashion. The mass of cells placed in each budding foot commences by acquiring a central cavity, or sometimes two or three adjoining one another; the cells which surround this cavity separate from their neighbours and become free in its interior. The whole of the elements of the mass gradually become involved in this process of dissociation; they increase in length, collect into bands crossing one another in different directions, and become transformed into muscle-fibres. The result is the production, in the space limited by the ectoderm of the limb, of a plexus of mesodermic elements; the meshes of this plexus are spaces filled with a liquid containing a few cells which have not undergone transformation, and which become the vascular sinuses of the appendage; the plasma which fills them and its cells represent the nutritive fluid. The fact that a little central cavity is primitively present in each young appendage has caused many embryogenists to admit the regular metameric division of the ventral mesodermic bands, and that, not only for the Crustacea, but also for the rest of the Arthropoda (excepting *Peripatus*, which appears to me to be wrongly included among the Arthropods). There is nothing in this mode of development which is comparable to the partitioning of the cœlome of the Annelids and Vertebrates; the whole process stops at the development in the appendages, while they are still quite small, of clefts which are destined to become blood-lacunæ and of which the first arises almost at the centre of the limb.

The mesoderm of the body also develops in a similar way; its elements, by devouring the nutritive yolk, occasion the formation of singular spaces, which communicate with one another and develop into blood-lacunæ; one of the latter, however, surrounding the intestine, becomes isolated from its neighbours and constitutes the peri-intestinal cavity. But before this separation is effected, a group of mesodermic cells, situated above the proctodœum, elongates and acquires a central cavity, which proceeds to unite with the mesodermic spaces; this hollow mass is the rudiment of the heart.

To sum up our results. The mesoderm is produced by almost the whole of the blastoderm, without the appearance of enterocœlic rudiments or diverticula; its elements develop by the mesenchymatous process; the sole representative of a cœlome is the ensemble of the circulatory apparatus and the perivisceral cavities, which has the value of a pseudocœle; no portion of it undergoes metamerization such as is met with in the Annelids or Vertebrates.—*Comptes Rendus*, tome cxiii. no. 3 (20 juillet, 1891), pp. 153–155.

② THE ANNALS

AND

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XLIV.—*Some Notes on British Ophiurids.* By F. Jeffrey Bell, M.A., Sec. R.M.S.

In revising the names and specific diagnoses of the British Ophiurids I have made one or two notes which it may be useful to publish.

1. *Ophiothrix fragilis* and *O. Luetkeni.*

Some time since (Journ. Mar. Biol. Assoc. (n. s.) i. p. 325) I ventured to say "Before long I hope to be able to marshal the evidence regarding the variability of *O. pentaphyllum* which is in my possession in such a way as to justify the doubts which Sir Wyville Thomson always had as to the distinctness of *O. Luetkeni.*"

The passage of a year has not diminished my knowledge of the variability of what I called *O. pentaphyllum*, because I was at the time using the nomenclature adopted by Mr. Lyman (*cf.* Bull. Mus. Comp. Zool. iii. p. 249); but a close examination of several specimens leads me to think that I cannot perform the promise that I made.

No absolute specific diagnosis has ever been made of what may appropriately be called Lütken's *Ophiothrix*; Thomson ('Depths of the Sea,' p. 100) regarded it as a variety of *O. fragilis,* and dedicated it "doubts and all" to Lütken.

In his invaluable critical study of the *Ophiotriches* of European waters Lyman (*t. c.* pp. 240–250) indicates some of the characters of *O. Luetkeni*, as he does also in his "key" to the species of *Ophiothrix* which he gives in his Report on the 'Challenger' Ophiurids; but, as I have already said, no definite specific diagnosis has been drawn.

Before going any further it is necessary to interpose a few words as to the name to be given to our common British species. Mr. Lyman was able to distinguish between the northern *O. fragilis* and the southern *O. pentaphyllum*; but, only a little later, he reports "*O. pentaphyllum*" from the Faroe Channel. This single little fact will show the great difficulty in discriminating and naming specimens of *Ophiothrix* better than any statement of mine. With all respect to Mr. Lyman I must be allowed to say that Dr. Lütken's views as to the identity of *O. fragilis* and *O. pentaphyllum* seem to represent better the facts of the case; and as *O. fragilis* is the older name, I shall henceforth use it for the common British *Ophiothrix*.

Though varying somewhat in size, *O. fragilis* is never a large species; *O. Luetkeni* may be roughly said to be twice as large. In the former the upper surface of the arms is distinctly keeled, each upper arm-plate projects forwards, and its aboral end is knobbed; these are some of the most characteristic marks of *O. fragilis*, but they seem to be altogether wanting in *O. Luetkeni*. The possession of minute spines by these upper arm-plates in the latter has been noted by Mr. Lyman, and is a very fairly constant character. The spines seem to vary more than he imagined, for there are specimens in which the stunting of the spines is so general that it is difficult to believe it is artificial.

It will, perhaps, be most convenient if I attempt first of all to draw up the specific diagnosis of the better-known species and then give one for *O. Luetkeni*.

Ophiothrix fragilis, L.

A species which exhibits the greatest variations in colour and marking and in the presence or absence of spines from the disk; of moderate size.

Arms very fragile, about eight to twelve times as long as the radius of the disk. The scales on the upper surface of the disk often form projecting spinules, but may be almost completely hidden by elongated delicate spines; the interrachial spaces below covered with fine spines. The triangular radial shields are of large size and are bare, except for

a few spines which may be present on the inner side of their base. Each is separated from its fellow by a few laterally compressed scales on which are spinous granules or short spines. The teeth-papillæ are exceedingly numerous, and beneath the clump are seven teeth. The arms are rather delicate; the upper arm-plates have a concave proximal and a strongly convex distal edge; the upper surface is carinate and the distal end of the keel forms a knob. The side arm-plates extend considerably on the proximal part of these plates and carry about seven spines, of which the uppermost is shorter than the next three or four, but not so short as the lowermost two or three. There is one tentacle-scale. The under arm-plates have the distal edge wider than the proximal and often concave outwards.

r.	R.
8	76 (arms broken).
5·5	55 ,, ,,
4·5	41
3·7	28

Ophiothrix Luetkeni, Wyv. Th.

A stout, well-grown species. Arms about ten times as long as the radius of the disk. The scales on the disk not unlike those of *O. fragilis*, and, as in it, they may or may not be covered with spines. The interbrachial spaces have the middle third occupied by fine spines, the sides bare. The triangular radial shields differ chiefly from those of *O. fragilis* in not having the spines or spinous granules confined to one angle. Teeth-papillæ coarse. Arms broad, flat, strong. The upper arm-plates somewhat variable in form, but always with a few fine spines, hardly at all carinate, with pretty even proximal and distal edges. Spines coarser and rather shorter than in *O. fragilis*, about seven in number. The lower arm-plates with a concavity outwards, but this is not very obvious in full-grown specimens. One tentacle-scale.

Colour white or banded and spotted with red or purplish.

The difference in size, the stouter arms and coarser spines, the bare interbrachial spaces, the spines on the radial shields and upper arm-plates, the loss of the keel, are sufficient to justify the distinctness of *O. Luetkeni*, at any rate in the present state of our knowledge.

2. *The Use of the Generic Term* Ophiura.

Since the commencement of his important work on Ophiurids, Mr. Theodore Lyman has used the name *Ophiura* for those

Ophiurids which were called *Ophioderma* by Müller and Troschel and which are distinguished by the apparent duplicity of their bursal clefts. This course he justified by citing one of the greatest authorities on Ophiurids—Dr. Lütken—who had declared two years previously that the type of Lamarck's genus *Ophiura* was *O. longicauda*, which is an *Ophioderma* in the sense of Müller and Troschel *.

I cannot tell whether Mr. Lyman accepted this statement of Dr. Lütken's without verifying it, or whether he looked upon the second species of an author's genus as being the type. If he did not verify the assertion he must be blamed; because if he had the readers of the 'Annals' would not have been burdened with this note. If he regards the second species as the type of a genus he is doing no more than exercising the privileges of a free man, and if he does not interfere with the liberty of others no one has the least right to complain.

But the questions are rather, (1) Was Dr. Lütken right? and (2) Was *Ophiura* at Mr. Lyman's disposal?

What Dr. Lütken thinks about it we are told in a footnote to p. 87 of vol. viii. (ser. 5) of the Dansk. Vid. Selsk. Skrifter (1870), where he says:—"Som bekjendt har Lyman ført Navnet *Ophiura* tilbage til *Ophioderma*-Slaegten og omdøbt Forbes' *Ophiura* til *Ophioglypha*. Skjøndt jeg maaskee selv har givet Anledning dertil ved hvad jeg (Addit. i. S. 31) har bemaerket om Anvendelsen af Navnet *Ophiura*, er jeg dog nu ikke vis paa, at det just var det rette."

In 1836 Agassiz † divided the existing species of Lamarck's genus *Ophiura* into *Ophiura* and *Ophiocoma*, and gave as types of the former "*O. texturata*, Lam.—*O. lacertosa*, Lam. &c." In 1839 E. Forbes ‡ gave a definition of *Ophiura* which would apply to *O. texturata*, Lamk., but not to *O. lacertosa*, Lamk., and in 1842 Müller and Troschel gave the name *Ophioderma* to the group of which the latter is the type.

By 1842, then, the partition of Lamarck's genus *Ophiura* as emended by Agassiz was completed, and no spoil was left for Mr. Lyman.

It follows therefore that those writers who have continued to use *Ophioderma* and have not allowed *Ophioglypha* to displace *Ophiura* are correct.

* See Proc. Boston Soc. N. H. vii. (1861) p. 197.
† Mém. Soc. Neuchâtel, i. p. 192.
‡ Mem. Wern. Soc. viii. p. 125.

3. *What is the Correct Name for the Common Sand-Star?*

This species has been called *Ophioglypha ciliata* by many. As has just been shown, it must be called *Ophiura* at any rate.

The earliest known *Asterias ciliata* is generally stated to be that of Retzius, the date of which is 1783, and not, as sometimes stated, 1805; but there is an earlier *A. ciliata*—that of O. F. Müller (1776)—which is clearly the same as *Asterias fragilis*, Linn.

So *ciliata* cannot be used.

But Retzius in his synonymy gives *A. ciliaris*, Linn., as a synonym of *A. ciliata*; reference to the figures cited by Linnæus from Linck shows that more than one species was included by him under that name, but an inspection of the figures of Barrelier shows that what we have called *O. ciliata* is to be taken as meant.

So, then, we have

Asterias ciliaris, Linn. (1766)* (part), = *O. ciliata*, auctorum (nec Houtyn, Linn. Nat. Hist. xiv. (1770), pl. cxiii. fig. 5).

Asterias ciliata, O. F. Müller (1776), = *Ophiothrix fragilis*, L.

A. ciliata, Retz (1783), = *A. ciliaris*, L. (part).

A. ciliaris, Lamk. (1801), = *Ophiothrix fragilis*.

4. *Asterias noctiluca*, Viviani.

Those authors, with one exception, who have taken the trouble to refer to Viviani's description of *Asterias noctiluca* (Phosphor. mar. (1805) p. 5) regard the name as synonymous with *Amphiura squamata*, which, again, appears to be a synonym of *Amphiura elegans*. This last specific name was applied in 1815 by Leach to an Ophiurid; but Viviani's tract bears date 1805. From Viviani's description, however, it is impossible to say that he definitely describes this common small form; and as we know that young Ophiurids of many kinds are phosphorescent, it is better to adopt the very sensible view of Messrs. Dujardin and Hupé that it is only a young form. It was possibly applied by its author to the young of several distinct species. I gather from Mr. Stebbing's 'Challenger' Report (*s. v.* "Viviani") that carcinologists

* The remaining part of *A. ciliaris*, L., seems to be *O. fragilis*, and as the *Ophiothrix* forms get a name from that day, the remaining must be called *O. ciliaris*.

have not been successful in determining the species of Crustacea described by Viviani in the pamphlet just alluded to.

5. *What is the Correct Specific Name of the "Shetland Argus"?*

To this species Forbes (1840) applied Linck's pre-Linnean and *generic* name of *Astrophyton scutatum*, generic not only because he calls it distinctly "genus," but because he distinguishes as "species"—"(1) Scuto rotato, ramis similaribus ex mari albo," "(2) Aliud Musei Regii Dresdensis," and "(3) Scuto striato pulvinato, ramis nodosis et frequentibus denticulis asperis;" it is therefore no more reasonable to write "*Astrophyton scutatum* (pars), Linck," among the synonyms of a species than it would be to write *Asterias* (pars), Linnæus.

Mr. Lyman calls the species *Gorgonocephalus Linckii*, applying Müller and Troschel's specific name (1842). Forbes without a query sign, Lyman with one, quote *Asterias caput-medusæ*, Linnæus; the latter refers to the 'Fauna Suecica,' without, however, saying that it is the second edition of that work which he quotes, the former to the 'Systema Naturæ.'

In neither case does the Linnean description afford any clue to any thing more than the genus, and neither author quotes the much fuller description which is to be found in the 'Museum regis Adolphi Frederici' (1754), p. 95; as this appears to be but little known I have reproduced it in a footnote *.

Even from this, however, it is impossible to be certain what species Linnæus had before him; and as he gives the Indian and southern oceans as well as the seas of Norway as the habitat, it seemed to me probable that more than one species, as we understand them, was before him. In this difficulty I turned as usual to the friendly assistance of Prof. Lovén, and, also as usual, I got the help I sought; Prof. Lovén tells me that in his opinion the specimen which was before Linnæus

* "*Asterias radiata*; *radiis dichotomis.*

"*Caput Medusæ.* Rumph. Mus. 41. t. 16.

"Habitat non tantum in OCEANO versus Norvegiam, sed et in australi et Indico.

"*Corpus* stella 5-fida, convexa, angulis in radios exeuntibus. *Radii* geminati, basi uniti, scabri. Foramen inter singulos lobos corporis utrinque. "*Centrum* hispidum supra ore quinquefido. *Rami* articulati, dichotomi innumeris dichotomiis, sensim tenuiores, pedales, sesquipedales; supra, utrinque, serie simplici ex punctis scabris, 4 s. 5. mucronibus."

is in the Stockholm Museum, and that it is an example of the *A. verrucosum* of Lamarck.

By writers on the British fauna the specific names *arborescens*, *caput-medusæ*, and *scutatum* have been used respectively by Pennant, Turton, Fleming and Couch; but in no one case is it possible to say with certainty whether or no they are speaking of the "Shetland Argus."

I cannot, I fear, pretend to the skill in divining intentions which is sometimes so marked a gift of the synonymist. Pennant, for example, gives nothing that to-day we can call a specific character; his reference to Linnæus's *caput-medusæ* is of no help. Pontoppidan is as entertaining as ever, but it is impossible to be sure what his species was.

Turton seemed to be more promising with his reference to Barbut and Shaw; the latter (Miscell. pl. ciii.) seems to have given his artist a Mediterranean form, while Barbut's figure (pl. x. fig. 12) is not as good as most of his.

In fine, the first description recognizable by me is that of Edward Forbes; and I venture to submit that no earlier description can with any confidence be said to apply to what we know as the "Shetland Argus."

It may perhaps be urged that, as there is only one British species of the genus, it is a refinement of exactness to pretend to be in ignorance of what these authors meant; but the premiss is not founded on fact, first because *Gorgonocephalus eucnemis* has been dredged by the 'Triton' in the Faroe Channel at a depth of 433 fathoms, and because of the geographical distribution ascribed to the "Shetland Argus"; this is a most important point—when a species is found in Norway, at Shetland, and the Orkneys it very often happens that it is not found further south otherwise than as a deep-sea form or as one of very extensive range. I cannot recall any species which is certainly known from Shetland and from Cornwall and not any intermediate station. The chances are that the Shetland form is a northern, the Cornwall a more southern or even Mediterranean form. The very distribution therefore leads one to suppose that two species have been found in the British seas *.

The difficulties that beset the student of English authorities are, with the exception of Lamarck, who appears to make,

* I should like to point out that, although we are not in science bound by such laws of evidence as brought rebuke on Sam Weller for repeating what the soldier said, yet the repeated citation of Borlase as the authority for Cornwall rests not on any statement in his own works, but on the remark of Pennant, "The late worthy Dr. William Borlase informed me that it had been taken off Cornwall."

pace Forbes, no reference to the species, not diminished by foreign writers; de Blainville's synonymy is most confusing, Agassiz was clearly in doubt as to what was *A. scutatum* and what *A. verrucosum.*

Müller and Troschel do not appear to have been satisfied with Forbes's description of "*A. scutatum*," and there can be no doubt that much confusion would result if that specific name were to be used; the term with which it is most often confounded is *verrucosum*, and that goes now that we know that it is synonymous with the *caput-medusæ* of Linnæus. *Scutatum*, then, should not usurp the place long occupied by the specific name given by Müller and Troschel.

Gorgonocephalus Linckii.

? *Astrophyton arborescens*, Penn. Brit. Zool. iv. (1777) p. 56 (non M. & Tr.).

? *Asterias caput-medusæ*, Turt. Brit. Faun. (1801) p. 140.

? *Astrophyton scutatum*, Flem. Brit. An. (1827) p. 489; Couch, Corn. Faun. i. (1838) p. 84 (non Gould, Inv. Mass. (1841) p. 345).

? *Euryale scutatum*, de Bl. Actin. (1834) p. 246.

Astrophyton scutatum, Forbes, Brit. Starf. (1840) p. 67 (non Agassiz, Mém. Soc. Neuch. ii. (1839), Notice &c., p. 11.

Astrophyton Linckii, M. & Tr. Syst. Ast. (1842) p. 122; Lyman, Ill. Cat. Mus. Zool. i. (1865) p. 190; Norman, Ann. & Mag. Nat. Hist. xv. (1865) p. 105.

Gorgonocephalus Linckii, Lyman, Chall. Rep. xiv. (1882) p. 264; Hoyle, Proc. R. Phys. Soc. Edinb. viii. (1885) p. 138.

XLV.—*Remarks on the Genus* Heterolepis, *Smith.* By G. A. Boulenger.

Although specimens of the West-African *Heterolepis poensis* have been frequently received during the forty years that have elapsed since the establishment, by Andrew Smith, of this curious genus of Snakes, the type species, *H. capensis*, remained one of the British Museum's most important desiderata. I was therefore extremely pleased to receive a few days ago, through the kindness of Mr. Trimen and Mr. Péringuey, of the South-African Museum, a specimen from Delagoa Bay, consisting of the head and anterior part of the body and the tail, of what I take to be the long-desired *H. capensis.*

This specimen agrees so well with Peters's *H. Gueinzii*, from Port Natal, that I entertain no doubt as to the identity of the two. The late Prof. Peters felt in fact very doubtful as to the propriety of separating *H. Gueinzii* from *H. capensis*,

which was only known to him from Smith's description and figure. The latter is probably incorrect; it is at any rate in contradiction with the text, in which the number of labials is stated to be seven, as in *H. Gueinzii* and the specimen from Delagoa Bay. The difference in the number of ventral shields (241, Smith; 203, Peters) and subcaudals (61, Smith; 51, Peters) cannot be regarded as outside the limit of variation which we may expect in any snake*. And I agree with Dr. Mocquard in suspecting the middle dorsal keel described and figured by Peters to be due to the projection of the neural spines. Smith gives as the habitat of his *H. capensis* "the eastern districts of the Cape Colony." The same species is recorded by Peters (Mon. Berl. Ac. 1876, p. 119) from the Ogowé, whence it has also been received by the Paris Museum, for I regard Mocquard's *H. Savorgnani* as a *H. capensis* in which the upper postocular has become fused with the supraocular. The specimen figured by Mocquard further agrees with the Delagoa-Bay specimen in the manner in which the enlarged vertebral scales begin on the occiput.

Perusal of Dr. Mocquard's paper on *Heterolepis* (Bull. Soc. Philom. 7, xi. 1887, p. 5) further suggests to me a few remarks:—

1. *Simocephalus Grantii*, Gthr., is not a *Heterolepis*. It differs in not having the maxillary and dentary bones angularly bent inwards anteriorly, in its subequal teeth, the anterior being but slightly longer than the posterior, the presence of apical scale-pits, and the absence of ventral keels. Although it has a præocular distinct from the loreal and only 15 rows of scales (19 on the neck), I feel disposed to refer it to Mocquard's genus *Gonyonotus* (Bull. Soc. Philom. 8, i. 1889, p. 146). The two species differ as follows:—

G. Brussauxi, Mocq.—Loreal and præfrontal entering the eye; temporals 2+2; eight upper labials, fourth and fifth entering the eye. Scales strongly keeled, in 21 rows.

G. Grantii, Gthr.—A loreal and a præocular; temporals 1+2; seven upper labials, third and fourth entering the eye. Scales rather feebly keeled, in 15 rows.

2. *Heterolepis glaber*, Jan, also belongs to a different genus, *Hormonotus*, Hallow., distinguished from *Heterolepis* by the large eye, the compressed body, and the smooth scales. The synonymy of the unique species is as follows:—

* The specimen from Delagoa Bay has only 45 subcaudals.

Hormonotus modestus.

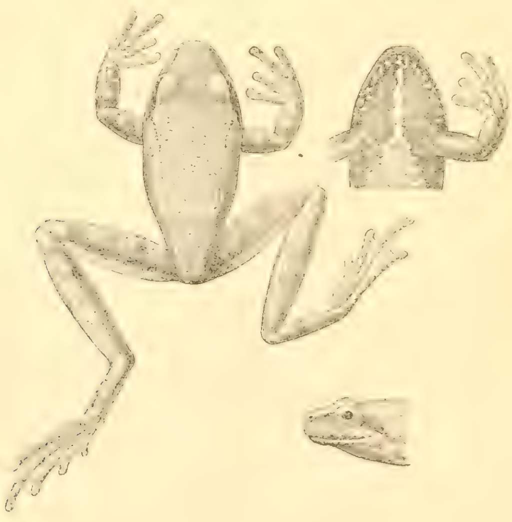
Lamprophis modestus, Dum. & Bibr. 1854.
Hormonotus audax, Hallow., 1857.
Hormonotus modestus, Günther, 1862.
Heterolepis glaber, Jan, 1863.
Boodon (Lamprophis) modestus, Peters, 1875.
Boodon (Alopecion) Vossii, Fischer, 1888.

3. *Heterolepis poensis*, Smith.—I am glad to say the type specimen is not lost. It is still in the British Museum, where it was registered in April 1847. The fact that its tail is mutilated accounts for the small number (67) of subcaudal shields. The *H. bicarinatus* of Duméril and Bibron (1854) is merely a synonym of *H. poensis*, Smith (1847).

XLVI.—*Description of a new European Frog.* By G. A. Boulenger.

Rana græca, sp. n.

Head a little broader than long, moderately depressed. Snout very short, rounded, not at all prominent, as long as the diameter of the eye; loreal region even less oblique than



in *R. temporaria* and *R. iberica*, very distinctly concave; nostril a little nearer the end of the snout than to the eye;

the distance between the nostrils a little greater than the interorbital width, which equals the width of the upper eyelid. Tympanum rather indistinct, half the diameter of the eye; its distance from the eye equals two thirds or three fourths its diameter.

Fore limb nearly as long as the body. First finger not extending beyond second; tips of fingers very obtuse, swollen; subarticular tubercles strongly developed. Hind limb very long, the tibio-tarsal articulation reaching beyond the tip of the snout. Tibia as long as the fore limb and longer than the foot. Toes nearly entirely webbed, even in the very young, with obtuse, swollen tips; subarticular tubercles large and prominent. Inner metatarsal tubercle soft, oval, measuring half the length of the inner toe; a very distinct tubercle at the base of the fourth toe.

Skin of upper parts rough with small warts.

Dorso-lateral fold narrow and not very prominent, sometimes interrupted, running straight from the temple to the groin; the distance between the dorso-lateral folds on the scapular region equals one fourth the length from snout to vent.

Grey or grey-brown above, with very indistinct darker spots and a band across the interorbital space; glandular lateral folds lighter; loreal region down to the border of the lip dark; a black canthal streak and a black temporal spot; a light streak from below the eye to the angle of the mouth; no large spots on the flanks; limbs with dark cross bands; hinder side of thighs dark brown with whitish dots. Throat much obscured with blackish-brown marblings, almost black, with a median white streak; a few large dark brown spots on the breast; belly white; lower surface of limbs reddish flesh-colour.

Vomerine teeth in two small groups, as in *R. temporaria* and *R. iberica*.

	millim.	millim.
From snout to vent	32	26
Length of head	12	10
Width of head	13	11
Diameter of eye	4	3·5
Interorbital width	3·5	3
From eye to nostril	2·5	2·5
,, ,, end of snout	4·5	4
Tympanum	2	1·5
From eye to tympanum	1·5	1
Fore limb	22	18
Hind limb	62	50
Tibia	22	17
Foot	19	15
Inner toe	4	3
Inner metatarsal tubercle	2	1·5

The specimens described are unfortunately not adult, and the male is still unknown to me.

The tadpole, although more nearly resembling that of *R. temporaria* than any other European species, differs from all its congeners in having the mouth quite as wide as the interorbital space, which equals once and a half the distance between the nostrils. The labial dentition is more developed even than in *R. temporaria*, the teeth forming four or five series in the upper lip, of which the second is but narrowly interrupted in the middle, and four in the lower lip; the latter are either all continuous, occupying nearly the whole width of the lip, or the fourth (counting from the labial edge) is broken up in the middle. A single series of papillæ on the lower labial edge. Tail obtuse, once and two thirds the length of the body, its depth about one third its length. Grey above, closely speckled with black, whitish beneath; muscular portion of tail reticulated with black; caudal crests with small black spots or arborescent markings.

	millim.
Total length	48
Body	18
Width of body	12
Tail	30
Depth of tail	10

It was through the tadpoles that I became aware of the existence in Greece of the species which I have now the pleasure of describing. About a year ago I received from Dr. Krüper, of Athens, several frog-larvæ, obtained on the Parnassos, which differed from anything I had seen before. One of the specimens was sufficiently near transformation to show remarkably long legs; and as *Rana Latastii*, of which I did not know the tadpole nor could refer to any description of it, had recently been recorded by Bœttger* from the neighbouring Korax Mountains, I thought I might safely refer it to that species. But having sent one of these larvæ to M. Héron Royer, the well-known connoisseur of European tadpoles, I was informed by him that it could not belong to *R. Latastii*, of which he had himself reared the tadpole; his letter was kindly accompanied by a specimen of the *R. Latastii*-larva, which, when I examined it a short time ago, left no doubt in my mind that my Parnassos tadpoles were erroneously named. The specimens obtained by v. Oertzen in the Korax Mountains being all in Berlin, as I was informed by my friend Dr. Bœttger, to whom I had

* Sitz. Akad. Berl. 1888, p. 148.

expressed my doubts as to the correctness of his determination, I applied to Professor Möbius, who had the great kindness of sending me for examination two of the Oertzen specimens. These proved, as I fully expected, to belong to a new species (identical with my specimens from the Parnassos), closely allied to *R. Latastii* and *R. iberica*, and, on the whole, nearer the latter, as may be seen from the following analysis :—

Adult.

R. græca.—Distance between the nostrils a little greater than the interorbital width; tympanum rather indistinct; first finger not extending beyond second; inner metatarsal tubercle half the length of the inner toe.

R. iberica.—Distance between the nostrils a little greater than the interorbital width; tympanum very distinct; first finger not extending, or extending but very slightly, beyond second; inner metatarsal tubercle one third the length of the inner toe.

R. Latastii.—Distance between the nostrils not greater than the interorbital width; tympanum very distinct; first finger extending beyond second; inner metatarsal tubercle one third the length of the inner toe.

Tadpole.

R. græca.—Series of labial teeth $\frac{4-5}{4}$, second upper continuous or narrowly interrupted, first lower at least two thirds the length of the second; width of mouth quite as great as the interocular space, which equals about once and a half the distance between the nostrils; tail obtusely pointed, about once and two thirds the length of the body.

R. iberica.—Series of labial teeth $\frac{3-4}{4}$, second upper widely interrupted in the middle, first lower not half as long as second; width of mouth much less than the interocular space, which equals nearly twice the distance between the nostrils; tail obtusely pointed, about once and a half the length of the body.

R. Latastii.—Series of labial teeth $\frac{3}{4}$, second upper widely interrupted in the middle, first lower not half as long as second; width of mouth less than the interocular space,

which equals once and a half the distance between the nostrils; tail acutely pointed, twice as long as the body.

The descriptions I gave of *R. iberica* and *R. Latastii* in 1879 were taken from a small number of specimens. I have rewritten the following, which I append for comparison with *R. græca*, upon the rich material which is now in the British Museum, viz. fourteen specimens of *R. iberica* (Coimbra, Serra de Gerez, Murça in Tras os Montes) and thirty-five of *R. Latastii* (Novara, Varese, Venice, Cordovado, Monte Lessini, Padua, Calcinaro, Castelfranco, Treviso, Florence, Bertonico, Turin).

Rana iberica, Blgr.

Head as long as broad or a little broader than long, moderately depressed. Snout short, obtuse, rounded; loreal region not very oblique, slightly concave; nostril equidistant from the eye and the end of the snout, or slightly nearer the latter; the distance between the nostrils a little greater than the interorbital width, which equals the width of the upper eyelid. Tympanum distinct, its diameter one half to three fifths the diameter of the eye; the distance between the eye and the tympanum equals two thirds to three fourths the diameter of the latter.

Fore limb nearly as long as the body. First finger not extending, or extending but very slightly, beyond second. Subarticular tubercles of fingers moderately developed.

Hind limb very long, the tibio-tarsal articulation reaching beyond the tip of the snout in the adult, to the tip of the snout in the young. Tibia but slightly shorter than the fore limb, and nearly as long as the foot. Toes three fourths or even nearly entirely webbed, the web more or less crescentically notched; subarticular tubercles moderately large and prominent. Inner metatarsal tubercle small, soft, oval, measuring about one third the length of the inner toe; a small and more or less indistinct tubercle is usually present at the base of the fourth toe.

The skin may be perfectly smooth, or the back rough with granules and small round warts; hinder side of thighs granular. Dorso-lateral fold narrow but rather prominent, running straight from the temple to the groin; the distance between the dorso-lateral folds on the scapular region equals two ninths to one fourth the length from snout to vent.

Coloration very variable. Upper parts yellowish brown, greyish brown, or reddish, with or without dark brown spots;

not unfrequently the back is largely blotched with yellowish and the sides may be spotted with pure white; a dark brown ∧-shaped marking sometimes present on the scapular region; the glandular folds usually with a dark brown outer margin; a dark brown canthal streak and a large dark brown or black temporal spot; a whitish streak from below the eye to the angle of the mouth; limbs with dark cross bands, which may be very indistinct; hinder side of thighs usually speckled or marbled with dark brown. Lower parts whitish, rosy under the limbs, and more or less profusely spotted or marbled with brown, especially on the throat and breast; the middle line of the throat, however, usually unspotted. Iris golden, brown in its lower moiety.

	Serra de Gerez.					Coimbra.		
	♂.	♀.	♀.	♀.	♂.	♂.	♀.	♀.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
From snout to vent	42	54	47	46	32	40	50	48
Length of head..........	14	17	15	15	12	14	16	16
Width of head	15	20	16	16	12	15	17	18
Diameter of eye	4	5	5	5	4	4	5·5	5·5
Interorbital width	3	4	4	4	3	3·5	4	4
From eye to nostril	3	4	3·5	3·5	2·5	3	3·5	3·5
" " end of snout	6	8	7	7	5	6	7	7
Tympanum	2·5	3	2·5	2·5	2	2·5	3	3
From eye to tympanum ..	2	2	2	2	1·5	2	2	2
Fore limb	26	35	30	29	22	28	31	31
Hind limb..............	78	98	87	83	60	74	86	90
Tibia	24	31	28	27	20	24	28	29
Foot	26	30	28	27	18	24	27	28
Inner toe	6	7	7	7	4	5·5	6·5	6·5
Inner metatarsal tubercle	2	2·5	2	2	1·5	2	2	2

Rana Latastii, Blgr.

Head nearly as long as broad, sometimes slightly broader than long, sometimes slightly longer than broad, more depressed than in *R. temporaria* and *R. iberica*, less so than in *R. agilis*. The snout varies much in shape; it may be short and rounded, as in a platyrhine *R. temporaria*, or as long, as pointed, and as prominent as in a typical *R. arvalis*; loreal region more oblique than in *R. temporaria* and *R. iberica*, less so than in *R. agilis*; nostril equidistant from the eye and the end of the snout, or slightly nearer the latter; the distance between the nostrils equals the interorbital width, which equals the width of the upper eyelid. Tympanum very

distinct, its diameter one half to two thirds the diameter of the eye; the distance between the eye and the tympanum equals one half to two thirds the diameter of the tympanum.

Fore limb as long as or a little longer than the tibia. First finger extending beyond the second. Subarticular tubercles of fingers moderately developed.

Hind limb very long, the tibio-tarsal articulation reaching beyond the tip of the snout; tibia as long as the foot or a little longer. Toes three-fourths webbed in the female, the web crescentically emarginate, three-fourths or nearly entirely webbed and with a straight or even convex border to the web in the breeding male; subarticular tubercles moderately large and prominent; inner metatarsal tubercle small, soft, oval, measuring about one third the length of the inner toe; a small outer metatarsal tubercle at the base of the fourth toe is usually present.

Skin smooth, or with a few small flat warts scattered on the back; back of the thighs granular. Dorso-lateral glandular fold narrow and more or less prominent, running nearly straight from the temple to the groin; the distance between the dorso-lateral folds on the scapular region equals one fourth to one fifth the length from snout to vent.

The coloration varies less than in *R. temporaria* and *R. iberica*, but more than in *R. agilis*. Upper parts greyish or reddish brown, usually with a few dark brown spots, a dark cross bar between the eyes, and a ∧-shaped marking on the scapular region; small orange or red spots may be present on the back, and, very rarely, a few ink-black blotches; the glandular lateral folds usually not paler than the surroundings, sometimes with a dark brown outer margin; no large spots on the flanks; a canthal streak and sometimes the whole of the loreal region dark brown; a dark brown or blackish temporal spot; a light streak from below the eye to the angle of the mouth; hind limbs with well-marked dark brown cross bars; hinder side of thighs speckled or spotted with brown. Lower parts pinkish white, the throat and the hind limbs often of a bright pink; throat and breast spotted or mottled with grey or brown, with the median line of the throat and usually a cross line on the breast unspotted, the two forming a ⊥-shaped light marking; belly and lower surface of thighs sometimes spotted, sometimes immaculate. Iris golden, much obscured with brown in its lower half.

	Castelfranco.		Turin.	Varese.		Novara.		Venice.	
	♂.	♂.	♀.	♂.	♂.	♂.	♀.	♀.	♀.
	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.	mm.
From snout to vent	48	43	58	55	54	45	58	56	56
Length of head..........	16	15	18	17	17	15	17	18	18
Width of head	15	14	18	18	18	15	18	18	18
Diameter of eye	5	4·5	5·5	5·5	5·5	5	5·5	6	6
Interorbital width	4	3·5	4·5	4·5	4	3·5	4	4·5	4
From eye to nostril	3·5	3·5	4	4	4	3·5	4	4	4
,, ,, end of snout	7	6·5	8	8	7·5	6·5	8	8	8
Tympanum	3	2·5	3·5	4	3·5	2·5	4	3·5	4
From eye to tympanum ..	2	1·5	2·5	2	2	1·5	2	2	2
Fore limb	30	28	37	35	35	29	34	37	35
Hind limb	84	76	109	95	97	86	103	104	104
Tibia	28	25	36	33	32	28	35	35	34
Foot	26	24	32	31	32	28	34	33	32
Inner toe	6	5	7·5	6·5	7	6·5	7	7·5	6·5
Inner metatarsal tubercle	2	1·5	2·5	2·5	2·5	2	2·5	2·5	2

XLVII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*——Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91. By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. Alcock, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Continued from p. 286.]

Family **Sergestidæ**.

Sergestes, H. M.-Edw.

22. *Sergestes bisulcatus*, W.-M.

Sergestes bisulcatus, W.-M. Ann. & Mag. Nat. Hist. (6) vii. 1891, p. 190, ♂ ♀.

A mutilated male and female from Station 109, 738 fathoms. Colour in the fresh state deep crimson.

23. *Sergestes mollis*, S. I. Smith.

Sergestes mollis, S. I. Smith, Rep. U. S. Fish. Comm. 1884, p. 419 [75], ♂ ♀, 1886, pl. xx. figs. 3–5, ♂ ♀.

A very fine male from Station 106, 1091 fathoms.

The spine at the distal end of the outer margin of the antennal scale is quite distinct, though small; the upper surface of the ocular peduncle is as if smeared with black pigment; and the subdorsal ridges of the telson bear near their distal end two pairs of very minute spinules.

Colour in life lurid red.

The specimen is very soft and delicate, and its carapace is hence much crumpled.

Total length from tip of rostrum to tip of telson 89 millim.

24. *Sergestes rubroguttatus*, sp. n.

Sergestes ? arcticus, W.-M. Ann. & Mag. Nat. Hist. (6) vii. 1891, p. 190, ♀ juv. (nec Kröyer).

♂ ♀. Closely allied to *Sergestes arcticus*, Kröyer (as figured by S. I. Smith in Bull. Mus. Comp. Zool. x. p. 96, pl. xvi. fig. 4, and Rep. U. S. Fish. Comm. 1884, p. 71, pl. viii. fig. 2, 1886, p. 92, pl. xx. figs. 1, 2), differing therefrom in the hepatic spine being so small as to be scarcely visible and sometimes obsolescent, in its longer and slenderer caudal appendages, and in the exopodites of these being without a trace of a spine on the outer margin.

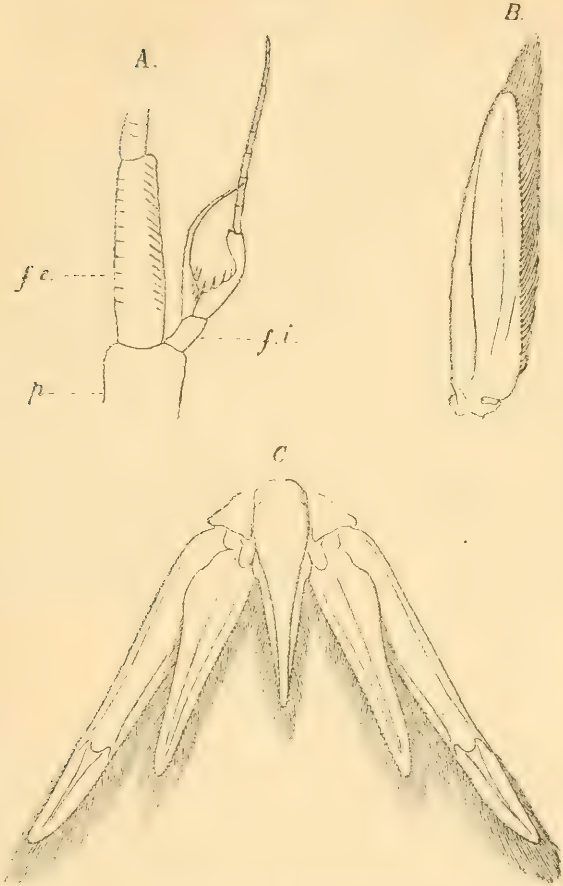
Colour in life hyaline, with blood-red spots.

Total length of a male 48 millim., of carapace from apex of rostrum to middle of hinder margin 15·5 millim., of external maxillipedes 32 millim., of the first pair of legs 25·5 millim., of the second pair 28·5 millim., of the third pair 31 millim., of the fourth pair 19 millim., of the fifth pair 9 millim.

The antennules of the male closely resemble those of *S. Frisii*, Kr. (Vid. Selsk. Skr. 5 Raekke, Naturvidens. og Mathem. Afd. 4 Bd. tab. i. fig. 1 *c*), the only difference being that the hook of the prehensile flagellum is roughened internally by fine, regularly parallel, transverse grooves or ridges instead of granules.

One female from Station 107, 738 fathoms; two males from Station 109, 738 fathoms; one female from Station 110, 1997 fathoms; and one male from Station 117, 1748 fathoms.

Fig. 10.



Sergestes rubroguttatus.

A, a portion of the left antennule of a male, from below, × 16·5. *p*, apex of peduncle; *f.e.*, basal or olfactory portion of external flagellum, with traces of the primitive segmentation indicated on the left and the lines of insertion of the olfactory setæ visible by transparence on the right of the drawing; *f.i.*, inner or prehensile flagellum.
B, left antennal scale, × 5.
C, caudal swimmeret, × 5.

EUKYPHOTES.

Family **Glyphocrangonidæ**.

Glyphocrangon, A. M.-Edw.

Section 1.

25. *Glyphocrangon investigatoris*, W.-M., var. nov. *andamanensis.*

Glyphocrangon investigatoris, Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. p. 191, ♀.

♀. Differs from the typical form in the following points:—It is much larger; the antennal, branchiostegal, and lateral spines of the carapace, especially the last-named, are more strongly developed, and the cervical groove is broader and deeper; the carapace with rostrum is, in proportion to the total length, somewhat shorter; the lateral and subdorsal ridges of the telson are much less distinctly and sharply granulated, being in fact little more than roughly waved; and, finally, the colour in life is uniform pink.

	Variety. millim.	Typical form. millim.
Total length from tip of rostrum to tip of telson	115	91
Length of carapace from middle of posterior margin to tip of rostrum	51	39
Length of carapace from front of the posterior rostral spines to middle of hinder margin	32	25·5
Length of rostrum from front of posterior spine to tip	20	15
Breadth between lateral spines of carapace	28·25	20·5
Length of abdomen	63	51

A young female differs from the above and from young of the same size and age of the typical form in its much longer rostrum, less tuberculate integument, longer and more divergent lateral carapacial spines, in all of which respects it recalls *G. aculeata*, A. M.-Edw.

The total length from tip of rostrum to tip of telson 55 millim., length of carapace from tip of rostrum to middle of posterior margin 26 millim., length of carapace from one of the posterior rostral spines to middle of hinder margin 13·5 millim., breadth between tips of lateral spines of carapace 14·8 millim., length of rostrum from front of one of the posterior spines 12 5 millim., length of abdomen 28·5 millim.

A very fine ovigerous female, with one young female, was taken at Station 115, 188 to 220 fathoms.

Colour in life in both pink; the eggs of the female pea-green. Colour of eyes in spirit dark purple.

26. *Glyphocrangon Smithii*, sp. n.

Very closely allied to *G. aculeata*, A. M.-Edw., from which it is distinguishable at a glance by the much less developed lateral spines of the carapace, the anterior of these being less expanded laterally and the posterior reduced to a minute though excessively acute point.

A comparison of our specimens with Milne-Edwards's type would probably reveal further differences.

Total length from tip of rostrum to tip of telson 77 millim., length of carapace from tip of rostrum to middle of posterior margin 35·5 millim., length of carapace from the front of one of the posterior rostral spines to hinder margin 20·5 millim., breadth between tips of lateral spines of carapace 18·2 millim., length of rostrum from the front of one of its posterior spines 16 millim., length of abdomen 41 millim.

Colour in life bright crimson. Eyes in spirit dark purple.

Two males from Station 112, 561 fathoms.

I have much pleasure in naming this species after Lieut. C. V. Smith, R.N., of the Survey.

Section 2.

27. *Glyphocrangon cæcescens*, sp. n.

Closely allied to *G. sculpta*, S. I. Smith, differing therefrom in the degeneration of its organs of vision, which, though perhaps not much if at all reduced in size, yet have their corneæ opaque yellow in every part except near the antero-lateral margins, where a faint touch of the original purple colour may still be traced; in having three pairs of rostral spines; in the rostrum being lanceolate when viewed from above (thus resembling that of *G. longirostris*, ♀ juv., S. I. Smith, Rep. U. S. Fish. Comm. 1886, pl. ix. fig. 5), and reaching nearly to the end of the olfactory flagellum of the antennules; in the dactylopodite of the legs of the last two pairs being minutely mucronate at the outer apex; in the posterior moiety of the subdorsal carapacial crest not being spinose; in the subdorsal ridges of the telson being minutely and acutely jagged.

Total length from tip of rostrum to tip of telson 65·5 millim., length of carapace from tip of rostrum to middle of

posterior margin 28·5 millim., length of carapace from front of second rostral spine to hinder margin 16 millim., length of rostrum from front of second spine to tip 12·75 millim., length of abdomen 37·5 millim.

Colour in life pale pink, with the corneæ dull yellow.

One male from Station 117, 1748 fathoms.

Section 3.

28. [*Glyphocrangon Gilesii*, W.-M.

Glyphocrangon Gilesii, Wood-Mason, Ann. & Mag. Nat. Hist. (6) vii. p. 193, ♀.

We here record a second female, somewhat smaller than the type, which has come to light in the sorting of past seasons' collections. It was taken on April 12th, 1888, 7½ miles east of North Cinque Island, Andaman Sea, in 490 fathoms.]

29. *Glyphocrangon cæca*, sp. n.

♂ ♀. This species differs from all the members of its own section in the enormous development of the spines of the anterior moiety of its lateral carapacial ridges, which are extended beyond the level of the frontal margin as in the species of Section 1, and from all the species of its genus in its greatly degenerate organs of vision, which, besides being somewhat reduced in size, have the corneæ yellow and densely opaque throughout. Both moieties of the lateral and the posterior moiety of the sublateral ridges are thick, blunt, and entire, but all the other ridges are broken up into tubercles; the subdorsal ridge is represented by six spiniform tubercles —three on each division of the carapace—the dorsal by six, of which two are behind the cervical groove and four in front of it; the latter have two closely-parallel rows of much smaller tubercles between them and their fellows of the opposite side; a minute median spinule projects from the anterior end of the gastric region over the gastro-rostral groove; between the anterior ends of the posterior moieties of the dorsal and subdorsal ridges an oblique row of four rather large granules bounds that portion of the cervical groove posteriorly.

With these exceptions the carapace is smooth and bears between its anterior lateral ridge and the gastric region on each side an unusually distinct low oval swelling. The antennal spine is unusually small—scarcely half the size of

the branchiostegal and only about one and a half times as large as the anterior rostral spines. The rostrum, which extends beyond the antennulary peduncle by about the length of the lateral spine of the carapace, is somewhat recurved and is marked on the dorsal surface by two rows of elongate foveæ, which are much more distinct in the female than in the male; its spines are small, especially the posterior, which are rather short and stout. The broadly oval antennal scale all but reaches the level of the end of the antennulary peduncle; the spine of its outer margin is rather well developed and is placed about one third of the way from the base to the apex.

The eyes are in both sexes somewhat reduced, in our only female very unequally so—the right being scarcely half the size of the left, while in our two males they would appear to be quite equal on both sides. From the opaqueness of the corneæ and other marks of degeneration it may with confidence be inferred that this species is quite blind.

The olfactory flagellum of the antennules is much thicker in the male than in the female. The dactylopodites of the last two pairs of legs are of the ordinary form—lanceolate, with the dorsal surface concave and the ventral subcarinate.

Abdomen much as in the preceding and probably other members of the same section; the dorsal ridge of its last tergum is in the female entire, in both males obsoletely notched; the dorsal ridge of the telson seems unusually long.

Colour in life bright pink.

	Male. millim.	Female. millim.
Total length from tip of rostrum to tip of telson	53·5	64
Length of carapace from tip of rostrum to middle of posterior margin	22	25
Length of carapace from front of posterior rostral spine to hinder margin	12·5	15
Length of rostrum from front of posterior rostral spine to tip	10	12
Length of abdomen	31·5	38
Breadth between points of lateral spines	12·3	13·6

Two males and one ovigerous female were taken at Station 112, 561 fathoms.

Family Crangonidæ.

Subfamily *Crangoninæ.*

Crangon, Fabr.

The two following species belong to the same section of the genus as *Crangon Sarsii*, Lilljeborg.

30. *Crangon bengalensis*, sp. n.

♀. Rostrum acuminate triangular, the unarmed tip extending by about half its length beyond the level of the eyes, armed at the sides with three pairs of sharp spines, of which the basal pair is only slightly more distant from the second pair than this is from the third pair. Eyes very short, owing to the reduction in length of the basal joint.

Median dorsal carina of the carapace divided into five forwardly-directed sharp spines; subdorsal carinæ continuous with the sides of the rostrum, also 5-spinose, with a considerable unarmed interval between its foremost spine and the basal rostral spine with which it is continuous; sublateral carinæ 3-spinose in their anterior half, ending abruptly some distance from the extra-orbital spines with which they are in line; lateral carinæ continuous with the antennal spines, unispinose near the anterior end; marginal carinæ entire, unarmed, continuous with the branchiostegal spines. The first abdominal tergum is furnished with six anteriorly spinose carinæ—two dorsal, two subdorsal, and two sublateral—as well as with unarmed rudiments of two lateral carinæ; the second tergum with three similar carinæ, of which one is dorsal and two are subdorsal, as well as with two unarmed sublaterals; the third and fourth terga have only an obtuse median dorsal carina, which in the latter is produced in the middle line posteriorly into a small point, as well as indistinct remains of sublaterals; the fifth and sixth have two posteriorly somewhat divergent sharp dorsal carinæ, which in the latter are minutely unispinose rather behind the second third of their length; the fifth has also two lateral carinæ and the sixth one.

Eyes in spirit dark chocolate-brown.

Total length from tip of rostrum to tip of telson 44 millim.; length of carapace from tip of rostrum to middle of posterior margin 13·5 millim., of abdomen to end of telson 30·5 millim.

One ovigerous female from Station 120, 240 to 276 fathoms.

31. *Crangon andamanensis*, sp. n.

Closely allied to the preceding, from which it differs in the following points:—(1) The two apical pairs of rostral spines are equidistant between the tip of the rostrum and the basal pair; (2) the rostrum is not so acuminate, its terminal portion being more broadly triangular; (3) the subdorsal carinæ of the carapace are only 4-spinose, the sublaterals are 5-spinose, and the laterals are usually bispinose; (4) the dorsal carina

of the second abdominal tergum is bispinose, and the dorsal carinæ of the sixth are 3- or 4-spinose; (5) it is a much larger and altogether finer species.

	Male. millim.	Female. millim.
Total length from tip of rostrum to tip of telson	62	72
Length of carapace from tip of rostrum to middle of posterior margin	18	20
Length of abdomen to end of telson	43·5	50

Colour in life chalky yellow. Eyes in spirit dark chocolate-brown.

Four males and two ovigerous females from Station 115, 188 to 220 fathoms.

PONTOPHILUS, Leach.

32. *Pontophilus gracilis*, S. I. Smith.

Pontophilus gracilis, S. I. Smith, Bull. Mus. Comp. Zool. 1882, x. p. 36, pl. vii. figs. 2–3 *a*; Rep. U. S. Fish. Comm. 1886, pl. xi. figs. 1, 2 (nec Sp. Bate, 'Challenger' Macrura, 1888, p. 487, pl. lxxxvii.).

One fine ovigerous female from Station 112, 561 fathoms, and a small and somewhat mutilated specimen from Station 113, 683 fathoms.

Colours in life transparent cloudy purple, corneæ milky orange. (In spirit rich orange-coloured and opaque.)

33. *Pontophilus abyssi*, S. I. Smith.

Pontophilus abyssi, S. I. Smith, Rep. U. S. Fish. Comm. 1884, p. 19, ♂ ♀, 1886, p. 49, pl. xi. figs. 3–5, ♂ ♀.

A fine female from Station 110, 1997 fathoms.

Colour in life translucent cloudy purple (dark orange in spirit), with the corneæ milky or chalky orange (in spirit Indian yellow and opaque).

Also a mutilated ovigerous female from Station 117, 1748 fathoms. Colour in the fresh state purplish, corneæ dull yellow. (In spirit as in the preceding specimen.)

The eyes in this species are decidedly shorter and less produced at the inner apex than in the preceding.

PRIONOCRANGON, gen. nov.

Integument smooth and polished. Carapace compressed, armed with a short, sharp, ascendant, narrow, triangular

ostrum, with antennal spines and with an arched median, dorsal, spiny crest on the gastric region. There is no trace either of eyes or even of eye-peduncles. First and third pairs of legs of the usual Crangonine form; second pair non-chelate, rather robust, with fringes of long plumose setæ, their dactylopodites minute, setulose; third and fourth pairs rather more robust than, but similar to, the second, with successively more minute and less gressorial dactylopodites, also furnished with long fringes of plumose setæ. Abdomen compressed, smooth, transversely convex, without spines or carinæ. Telson thin and depressed.

34. *Prionocrangon ommatosteres*, sp. n.

The serrated gastric crest is seven-toothed.

The animal measures in length, from tip of rostrum to tip of telson, about 30 millim., of which the carapace from tip of rostrum to middle of hinder margin is about 10 millim.

A single somewhat mutilated specimen from Station 116, 405 fathoms.

[To be continued.]

XLVIII.—*The Biological Import of Amitotic (Direct) Nuclear Division in the Animal Kingdom.* By H. E. Ziegler, Ph.D., Extra-ordinary Professor of Zoology, Freiburg i. B. *

In W. Flemming's most recent paper † we find the following passage:—"As regards the fragmentation of the nuclei of leucocytes—and amitotic nuclear division in general—it appears to me not impossible that the following view could also be held. The leucocytes, like the cells of other tissues, perform their normal physiological reproduction by means of mitosis; those cells only which have come into existence by this process preserve the faculty of continuing to live and of producing similar cells in the same manner. *Fragmentation of the nucleus, with and without subsequent division of the cell, is universally a process in the tissues of Vertebrates, which*

* Translated from the 'Biologisches Centralblatt,' Bd. xi. nos. 12 and 13, pp. 372–389, July 15, 1891.

† W. Flemming, "Ueber Teilung und Kernformen bei Leukocyten und über deren Attraktionssphären," Archiv f. mikr. Anatomie, 37 Bd., 1891.

does not lead to the physiological multiplication and reproduction of cells, but, on the contrary, represents where it occurs a degeneration or aberration, or perhaps in many cases (formation of multinuclear cells by fragmentation) is subservient to the metabolism of the cell by increasing the periphery of the nucleus. According to this theory, therefore, if leucocytes divide with fragmentation of their nuclei, the products of this process would no longer be material possessing reproductive power, but, on the contrary, would be destined to destruction, although they may still be able to continue to live for a long time in the tissues and juices."

Although Flemming writes the foregoing sentences merely as probable hypotheses, and not as proved results, they are nevertheless of great importance, and Flemming's development of his theme will largely contribute towards bringing into general recognition the true interpretation of amitotic nuclear division *. For many years past I have cherished a similar view with regard to the biological import of amitotic nuclear division to that which is expressed in the above-quoted sentences of Flemming, and I have since found it confirmed in all cases of amitotic nuclear division which have come under my notice in literature; I therefore believe that amitotic nuclear division, wherever it appears, is to be interpreted in the sense of the exposition which I have just cited.

The study of the nuclei in the periblast of Teleostei had been my starting-point in such considerations †. "The nuclei in the periblast of Teleostei divide at the time of segmentation by karyokinesis, as a number of authors agree in affirming; subsequently, however, they acquire a peculiar appearance ‡, and exhibit the figures of direct nuclear

* Amitotic nuclear division includes, according to Arnold's terminology, "direct segmentation," "direct fragmentation," and "indirect fragmentation." I disregard Arnold's designations entirely, since, as it appears to me, they are based upon an unnatural classification.

† E. Ziegler, "Die Entstehung des Blutes bei Knochenfischembryonen," Archiv f. mikr. Anatomie, 30 Bd., 1887, p. 160.

‡ The same phenomena are seen not only in the case of the nuclei of the other meroblastic Vertebrates which lie in the yolk, but also in that of the yolk-contained nuclei of the Arthropods. Just as in the development of the meroblastic ova of Vertebrates it is in the highest degree improbable, and at least not yet proved, that the large nuclei lying in the yolk take any morphological share whatever in the building up of the embryo, so the same assertion can be maintained for those nuclei which in the Arthropods still remain in the yolk after the formation of the blastoderm and of the rudiment of the primitive streak. I quote the observations of Graber on this point ("Vergleichende Studien über der Embryologie der Insekten und insbesondere der Musciden," Denkschriften der k. Akademie zu Wien, Math.-naturw. Klasse, 56 Bd., 1889):—

division." In my previous paper I dilated upon the fact that "in cases of a widely different character we find peculiar forms of nuclei, which we may class together with the nuclei of the periblast of Teleosteans, and that these phenomena constitute an important chapter for the natural history of the cell-nucleus in general." "It would seem fitting were we to use the expression fragmentation in the animal kingdom (and, indeed, in the first place only for the Metazoa) for those morphologically and physiologically associated cases which are characterized as follows. The nuclei are considerably larger than the ordinary nuclei in the same animal, and exhibit an abnormal poverty, or an abnormal distribution, of chromatin. The nuclei multiply by direct nuclear division; it often happens that the division is not carried as far as the separation of the segments, so that the nuclei show bud-like processes and irregular prolongations, or appear divided by constrictions. Fragmentation occurs in cells which no longer undergo division, or in masses of protoplasm which have arisen through incomplete cell-division (*i. e.* through nuclear division without concomitant division of the cell). The appearance of fragmentation is connected with the fact that the cell has become specialized, has adapted itself to a definite physiological function, that, for instance, it is harbouring and assimilating food-yolk, is performing some process of secretion or absorption, &c. The nuclei have degenerated, in so far as the cell is no longer capable of division, and consequently can no longer morphologically take part in the further building-up of the embryo or in processes of regeneration; if in this sense we designate the nuclei as degenerate, this does not preclude them from performing their physiological function for a longer or shorter time. There are simpler modes of degeneration which lead to speedy destruction; fragmentation only occurs when the nuclei first undertake a specialized function and then perish."

"Within the blastoderm, scattered about in the yolk, are found, as is well known, in the Muscidæ, as well as in all Insects hitherto investigated, cells, or at least nuclei, which we consequently very frequently term yolk-cells ("Vitellophaga," according to Nussbaum). Now as regards the share which these much-discussed cells take in the building-up of the embryo, at present far the most generally accepted view is that they merely assist in the assimilation of the yolk, and that, although they and the cells of the blastoderm have a common origin, the former elements take no special part in the formation of tissues, and are not to be included in the category of the true germinal layers." The vitellophaga of the Muscidæ are nuclei without a plasma-envelope, and appear "as generally very irregularly defined or amœboid structures of relatively gigantic size."

According to the present stage of our investigations we may assert that *the amitotic division of the nucleus always indicates the end of the series of divisions.* Where this mode of division appears, only a limited number of divisions, or only very few, or none at all take place, while the nuclei which divide by mitosis possess an unlimited capacity for multiplication for the whole duration of the life of the individual. It is even *à priori* hardly probable that nuclei which have arisen by amitotic division will ever divide again by mitosis; for in amitotic nuclear division the distribution of the chromatin takes place in a rough and usually very irregular fashion; in consequence of this, mitosis, which effects a methodical and altogether equable division of the chromatin, would subsequently have no importance at all and no further value, or it would at least remain quite unintelligible.

Flemming shows (*loc. cit.*) that, in the amitotic division of the nuclei of leucocytes, *in connexion with the constriction of the nucleus a division of the attraction-sphere and of its central body does not take place* *. Into connexion with the absence of this division it is perhaps possible to bring the fact that *division of the cell does not usually follow amitotic nuclear division.* As Flemming remarks, further investigations will have to decide whether, in those cases in which amitotic

* This observation gives an important support to the view that the processes of amitotic nuclear division and of branching of the nuclei are connected with and merge into one another; the unusual size also is a feature common both to the nuclei which are branched and to those which divide without mitosis. Korschelt ("Beiträge zur Morphologie und Physiologie des Zellkerns," Zool. Jahrbücher, Abteilung für Anat. und Ontogenie, Bd. iv., 1889) has shown in comprehensive fashion that branched nuclei frequently occur in cells such as those in which an intense secretion takes place. The branching of the nuclei points to the fact that they have adapted themselves to a large extent to the specialized physiological function, and this far-reaching adaptation involves the destruction of the nuclei after a longer or shorter interval. That there is a physiological and morphological connexion between the amitotic division and the branching of the nuclei is also to be deduced from the fact that they frequently occur side by side; for instance, in some preparations of the whole of the alimentary canal of *Porcellio scaber* (which Dr. vom Rath most kindly allowed me to examine) I observed that the nuclei of the epithelium of the posterior half of the mid-gut exhibited manifold ramifications and here and there the figures of direct division. I would remark in passing that forms of nuclei such as we meet with in this instance have been described and figured by van Bambeke ("Des déformations artificielles du Noyau," Archives de Biologie, t. vii., 1887), but that I am unable to discuss his paper further, because I am not perfectly clear as to what van Bambeke wishes to convey by the expression "Déformation artificielle."

It will perhaps be advisable to make a subdivision for those cases of amitotic nuclear division which occur in conjunction with branching of the nuclei.

division is accompanied by a division of the cell, a division of the attraction-sphere takes place.

According to all the investigations which have hitherto been made, it is a matter of certainty that *those nuclei which divide without mitosis are always distinguished by their excessive size* *. This peculiarity appears also to occur in the case of the leucocyte-nuclei which divide without mitosis, although it is not so noticeable here as elsewhere. The unusual size is undoubtedly connected with the physiological function, and, in my opinion, it is permissible to advance the hypothesis that in the Metazoa *amitotic nuclear division occurs* (*chiefly*, *perhaps exclusively*) *in such nuclei as minister to a process of unusually active secretion or assimilation.* With regard to this theory, I will now consider a few cases of amitotic division.

The regressive changes which set in in the egg-cells in the vertebrate ovary take place with the help of leucocytes, which creep into their interior, and of cells which penetrate the outer wall of the egg-cell from the epithelium of the follicle, which has become multilamellar; the nuclei of the cells which effect the absorption of the egg-cell degenerate while continuing to increase in size, and exhibit amitotic division. The physiological conditions in this instance are the same as in the nuclei in the yolk of meroblastic Vertebrates, in so far as it is

* In some cases large nuclei of this kind have had the term "*giant*" applied to them. It would be advisable always to employ the same name for all unusually large nuclei occurring in the Metazoa (with the exception of the nuclei of the genital cells). In this sense we could generalize the expression "giant nucleus." The term macronucleus, which is employed in speaking of the ciliated Infusoria and Acinetaria, should not be transferred to the Metazoa, for, indeed, the Protozoa in question occupy a position quite by themselves with reference to nuclear conditions. For the type of unusually large nuclei which is found in the Metazoa I would propose the name "*meganucleus*." Recent discoveries may then be stated very briefly as follows:—Where meganuclei occur there takes place a process of active secretion or assimilation; meganuclei can divide without mitosis, and amitotic nuclear division among the Metazoa occurs only in meganuclei; meganuclei have only a limited capacity for division, and always perish after a time.—It would be advisable to give the nuclei of the genital cells an exceptional position, and not to include them among the meganuclei. It is true that the nucleus of the ovum, adapting itself to the ovogenetic processes, attains an extraordinary size, but its bulk is capable of diminution; while in the case of a typical meganucleus, so far as we know, mitotic division never again takes place, the nucleus of the ovum undergoes mitotic division in giving rise to the first directive vesicle. In the nuclei of somatic cells the adaptation to a definite physiological function could advance so far as to annihilate the normal faculty for division; in the nuclei of the genital cells this naturally could not take place.

a question of exercising an assimilating influence upon the yolk-material. The changes undergone by the leucocytes and follicle-cells during the absorption of the egg-cell, and especially the enlargement of the nucleus, the manifold forms of the amitotic division, the occurrence of multinuclear cells, and the disintegration of nuclei, have recently been minutely investigated by Ruge* in different Amphibia. Ruge's paper contains so many observations of importance for the question before us that I must refer the reader to it, and cannot here attempt to recapitulate his results in a few words.

A very typical case is that which has been described by Chun †. In the nectocalyces of the Calycophorid Siphonophora we find in the radial canals and in the anastomosing offshoots from them "the large flattened endoderm-cells filled with a brood of nuclei." "The larger ones among them rarely exhibit rounded contours; generally they show a band-like or vermiform elongation, and are beset with lateral papillæ." "Sometimes dumb-bell- or biscuit-shaped nuclei constrict into two equal halves, while at others the division of the nucleus more resembles a budding, in so far as the nucleus which is constricted off is considerably smaller, while the larger nucleus simultaneously exhibits various proliferations, which likewise commence to constrict." "In no case does the direct division of the nucleus in the Siphonophora entail a subsequent division of the cell;" Chun lays special stress upon this fact, "since, moreover, in all cases where direct nuclear division has hitherto been shown to exist we get a formation of multinuclear cells, but no certain evidence of a subsequent division of the cell." It appears to be probable that the nuclei described by Chun possess an energetic physiological activity of the kind mentioned above; for the formation of the plexiform anastomosing offshoots of the radial canals points to the fact that the epithelium of these canals is destined to come into contact with the surrounding tissues to the largest possible extent, and, as Chun asserts, is of great importance for the metabolism of the musculature of the nectocalyces which effects the swimming-motion.

In many insects we find nuclei of quite remarkable size in the nutritive cells, which collect round the egg-cell in the ovary in order to supply it with nutrient material ‡; in

* G. Ruge, "Vorgänge am Eifollikel der Wirbeltiere," Morphologisches Jahrbuch, xv. Bd., 1890.

† C. Chun, "Ueber die Bedeutung der direkten Kernteilung," Schriften der physikal.-ökon. Gesellschaft zu Königsberg i. Pr., 31 Jahrg., 1890.

‡ Compare also the figure of the large nutritive cells of *Musca vomi-*

nutritive cells of this kind in the terminal chamber of the ovaries of different species of bugs Korschelt * has observed the figures of amitotic nuclear division.

In the follicle epithelium which envelopes the ovum of the mole-cricket ("le tapis cellulaire qui recouvre l'œuf de la taupe-grillon arrivé à l'état parfait") Carnoy † saw amitotic nuclear division and multinuclear cells. Since the cells of the epithelium of the follicle play a great part in the nourishment of the growing egg-cell, and since they lose their importance when the egg-cell becomes fully ripe, the biological conditions which we have emphasized above exist in this case also.

In the large nuclei of the external layers of the embryonic envelope of a Brazilian scorpion direct division has been observed by Blochmann ‡. "A division of the cell in connexion with this division of the nucleus probably never occurs in any case." In none of his preparations did Blochmann find an indication of cell-division; "the absence of cell-division is also attested by the large number of binuclear cells which are found in all parts of the embryonic envelope." "The embryonic envelope is a transitory structure, which certainly undergoes disintegration soon after these divisions." Whether this embryonic membrane has an important physiological function, whether it perhaps secretes a serous fluid which surrounds the embryo, cannot at present be determined.

In *Cyclas cornea* (a small freshwater mussel) I have observed a striking enlargement and peculiar fragmentation in the nuclei of the epithelium of the brood-pouches, which arise in the gills and surround the embryos §. A fluid gradually accumulates in the brood-capsules; a secretory function on the part of the cells is therefore rendered probable. Certain of the epithelial cells separate from the wall and are devoured by the embryos, which continue to grow within the brood-capsules until they attain sexual maturity.

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toria in Henking's paper "Die ersten Entwicklungsvorgänge im Fliegenei," Zeitschr. f. wiss. Zoologie, Bd. 46, 1888.

* Korschelt, "Ueber die Entstehung und Bedeutung der verschiedenen Zellenelemente des Insektenovariums," Zeitschr. f. wiss. Zoologie, Bd. 43, 1886.

† J. B. Carnoy, "La Cystodiérèse chez les Arthropodes," La Cellule, t. i., 1884, p. 219.

‡ Blochmann, "Ueber direkte Kernteilung in der Embryonalhülle der Skorpione," Morphol. Jahrbuch, x. Bd., 1885.

§ H. E. Ziegler, "Die Entwicklung von *Cyclas cornea*," Zeitschrift für wiss. Zoologie, 41 Bd., 1885.

The epithelium of the urinary bladder of different mammals, especially the mouse and the dog, has recently received a minute investigation at the hands of A. S. Dogiel, who writes as follows * :—" In one and the same multilamellar epithelium we find amitotic nuclear division in the cells of the upper layers, and mitotic in those of the remaining layers." " In different mammals, but chiefly in the small Rodents, the uppermost epithelial cells of the urinary bladder are of an extraordinary size, and possess a large number of nuclei." " We see that the process of multiplication of the nuclei in the epithelial cells of the uppermost layers is similar to that which is found in the giant cells, leucocytes, epithelium of the mammary glands, &c., namely direct amitotic nuclear division, or even, more properly speaking, bud-formation." The uppermost cells of the epithelium of the urinary bladder have a secretory function and give rise to the layer of mucus, " which protects the mucous membrane of the bladder from the effects of direct contact with the urine." If we further reflect that in multilamellar epithelia the uppermost layer of cells always undergoes a gradual degeneration and is regenerated from the deeper layers, we see that in the case of amitotic nuclear division before us the biological conditions are perfectly typical †.

In cells which are typical gland-cells amitotic division of the nucleus is not rare ‡. *Gland-cells in which an active secretion takes place always have a considerable bulk and usually a large nucleus* §, *which never divides by mitosis* ;

* A. S. Dogiel, " Ueber das Epithel der Harnblase," Archiv f. mikrosk. Anatomie, 35 Bd., 1890.

† Amitotic nuclear division in the epithelium of the bladder has been found not only in Mammals, but also in Urodela. Flemming observed it in the Salamander, but is inclined to regard its occurrence not as normal, but rather as pathological (Flemming, " Amitotische Kernteilung im Blasenepithel des Salamanders," Archiv f. mikr. Anat. Bd. 34, 1890).

‡ The secretion of milk is allied to glandular secretion, yet we cannot regard the milk-cells as typical gland-cells, for the body and the nucleus of the cell are not appreciably enlarged. Nissen (Archiv f. mikr. Anat. Bd. 26, 1886) writes as follows on the subject of milk-cells :—" In hundreds of preparations I have not been able to detect mitoses, in spite of the fact that multiplication of the nuclei is an extremely frequent occurrence. Perhaps, therefore, direct nuclear division takes place in this case. However this may be, the nuclei lying at the inner end of the cell separate from the epithelial cells surrounded by a portion of protoplasm."

§ Korschelt (" Ueber die Bedeutung des Kerns für die tierische Zelle," Sitzungsber. der Gesellschaft naturf. Freunde zu Berlin, 1887, p. 127) writes :—" It is highly remarkable that the bulky nuclei . . . . occur precisely in cells which have a secretory function. This may point to the

if amitotic division of the nucleus sets in, it is not usually followed by division of the cell.

In *Triton* (according to Klein *) the figures of amitotic nuclear division are met with in the large gland-cells which clothe (or, more correctly speaking, fill) the sac-shaped dermal glands, and multinuclear cells are also found among them.

In *Anilocra* (an Isopod Crustacean) O. vom Rath † found very large nuclei, which divide without mitosis, in large glandular cells, which in all probability are the salivary glands of the animal; several nuclei are often found in one cell.

We now come to the cases of direct nuclear division which are met with in the epithelium of the alimentary canal of Crustacea and Insects ‡, in the hepatic tubules of Crustacea, and in the Malpighian tubes of Insects. For we have here always to deal with cells of a glandular character.

With regard to the Malpighian tubes, amitotic division was found in the larva of *Aprophora spumaria* by Carnoy § and in *Dytiscus marginalis* by Platner ||. "The cells of the Malpighian vessels of Insects," writes Platner, "are exceeded in size only by the ova. The diameter of the nucleus is often three times larger, and even more, than that of the cells of the Salamander, and at the same time, in spite of the most vigorous multiplication of cells, necessitated by the consumption which takes place when the organs are doing their work, we find no mitosis. We meet with the greatest difference in the size of the cells; the large cells contain one large nucleus,

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fact that the nuclei are of quite extraordinary importance for such cells, that they exercise a certain influence on the activity of the cell. We receive further support for this conjecture in the fact that the nuclei do not at first possess the considerable circumference and unusual form, but only acquire these when the cells enter upon their functions."

* E. Klein, "Observations on the Glandular Epithelium and Division of Nuclei in the Skin of the Newt," Quart. Journ. Micr. Sci. vol. xix. 1879.

† O. vom Rath, "Ueber eine eigenartige polyzentrische Anordnung des Chromatins," Zoologischer Anzeiger, 1890, p. 334.

‡ In Nematodes also amitotic nuclear division occurs in the epithelium of the alimentary canal. Hoyer found the figures of direct nuclear division and multinuclear cells in the alimentary canal of sexually mature individuals of *Rhabdonema nigrovenosum* (Hoyer, "Ueber ein für das Studium der 'direkten' Kernteilung vorzüglich geeignetes Objekt," Anatom. Anzeiger, 5 Jahrg. 1890, p. 26).

§ J. B. Carnoy, "La Cytodiérèse chez les Arthropodes," La Cellule, t. i., 1884, p. 219.

|| G. Platner, "Beiträge zur Kenntnis der Zelle und ihre Teilungserscheinungen," Archiv f. mikrosk. Anatomie, 33 Bd.

or two smaller ones, or even three, four, or five; the nuclei themselves are found in all stages of direct division.

The conditions presented by the epithelium of the mid-gut of Insects * and Crustacea require special discussion. After a critical examination of the literature we must arrive at the conclusion that in such epithelial cells as are already functioning as gland-cells, or in which the process of secretion is just beginning, direct nuclear division may occur; that these cells and their nuclei are then gradually or periodically cast off, and that the regeneration of the epithelium usually proceeds from isolated groups of young cells, or from regeneration-pits, the cells of which multiply by mitosis. Frenzel's† observations also admit of interpretation in this sense. This author noticed in the intestinal epithelium of *Phronima* a few scattered islands of younger cells, which were not engaged in secretion and multiplied actively by mitosis. In *Astacus*, *Maja*, and *Dromia* he observed typical amitotic nuclear division ‡. As regards Insects, Frenzel writes as follows:—"The cells of the mid-gut have to perform the task of furnishing the digestive secretion, and a portion of them, namely the true epithelial cells, in the caterpillars the columnar as well as the mucous-cells, constantly perish in so doing" §. "The true epithelial cells in the mid-gut of Insects, it matters not whether they belong to the actual intestinal tube or to its evaginations, or whether they are to be ascribed to the type of elongated columnar cells, or to that of rounded mucous cells, propagate by the method of direct amitotic nuclear division." So far Frenzel's statements agree very well with

* Amitotic nuclear division occurs not only in the mid-gut, but also in the hind-gut of Insects. Faussek ("Beiträge zur Histologie des Darmkanals der Insekten," Zeitschr. f. wiss. Zoologie, Bd. 45, 1887) observed it in the hind-gut of a grasshopper (*Eremobia muricata*, Pall.) and in the rectal glands of *Æschna*-larvæ. So far as we know, this division of the nucleus is not followed by a division of the cell.

† J. Frenzel, "Ueber den Darmkanal der Crustaceen nebst Bemerkungen zur Epithelregeneration," Archiv für mikrosk. Anat. 25 Bd., 1885; "Einiges über den Mitteldarm der Insekten, sowie über Epithelregeneration," Archiv für mikrosk. Anat. 26 Bd., 1886.

‡ I have noticed in sections of *Astacus* that the nuclei of the epithelial cells of the mid-gut, in certain regions lying in the depths of the folds, have the appearance of young nuclei, which probably divide by mitosis.

§ The way in which the secretion collects in the cells of the mid-gut of Insects, and how such cells, with their nuclei, are cast off into the lumen of the intestine when the secretion is poured forth, has been minutely described by A. van Gehuchten ("Recherches histologiques sur l'appareil digestif de la larve de *Ptychoptera contaminata*," La Cellule, t. vi. 1890). Mingazzini, too, alludes to the casting off of the epithelial cells ("Ricerche sul canale digerente dei Lamellicorni fitofagi," Mitt. a. d. zool. Station zu Neapel, ix. Bd., 1889, pp. 55 and 279).

the theoretical views which may be brought to bear on the point. But Frenzel continues :—" while the specific gland-cells of the pits multiply by the method of indirect (mitotic) nuclear division." Frenzel considers, therefore, that the epithelial cells multiply by amitotic division, the gland-cells by mitosis, and this view stands in abrupt contradiction to the statements above. The state of the case is very easily explained when we consider that the cells of the pits, which divide by mitosis, furnish not the slightest grounds for being regarded as gland-cells; the body of the cell is small and contains no drops of secretion. Much more light is consequently thrown upon the matter by regarding the pits not as glandular, but as regenerative, and assuming that the "true epithelial cells" are regenerated and thrust forward therefrom. In *Periplaneta orientalis*, L., I have by the study of sections convinced myself of the justice of this view.

We should therefore have no grounds whatever for the assumption, were we to conclude that in the intestinal canal of Crustacea or Insects the multiplication of cells is based upon amitotic nuclear division, and it appears, on the contrary, that amitotic nuclear division only occurs in such cells as are in the act of functioning as gland-cells and which sooner or later will perish in so doing. It may here be also mentioned that in many Arthropods there takes place at a certain time a shedding of the whole glandular epithelium of the mid-gut. According to Bizozzero (Atti della R. Accad. d. Sc. di Torino, vol. xxiv. 1888–89, p. 702) in *Hydrophilus piceus* the whole epithelium of the mid-gut is shed every two to five days, and the new epithelium is formed from the "intestinal glands" (regeneration pits) by protrusion and metamorphosis of the cells. In Polydesmids it was observed by O. vom Rath * that during ecdysis the epithelium of the mid-gut is shed and regenerated. In Hymenoptera the epithelium of the mid-gut is renewed during the pupa state (*vide* Frenzel, *loc. cit.* p. 257). The dissolution of the existing mid-gut epithelium in the pupa stage of the Muscidæ has long been known owing to the fundamental investigation of Weismann †, and the development of the new epithelium has recently been described by Kowalevsky ‡ and van Rees §. The latter writes as

* O. vom Rath, "Ueber die Fortpflanzung der Diplopoden (Chilognathen)," Berichte der naturf. Gesellschaft zu Freiburg i. B., Bd. v., 1890, p. 13.

† A. Weismann, "Die nachembryonale Entwicklung der Musciden," Zeitschrift f. wiss. Zoologie, 14 Bd., 1864.

‡ A. Kowalevsky, "Beiträge zur Kenntnis der nachembryonale Entwicklung der Musciden," Zeitschr. f. wiss. Zoologie, 45 Bd., 1887.

§ J. van Rees, "Beiträge zur Kenntnis der innern Metamorphose von

follows:—"The whole internal epithelial tube, as well as a number of smaller cells which I am inclined to regard as connective tissue, is cast off into the lumen. Only a number of epithelial islets remain behind, nestling closely against the at present undissolved larval muscular layer."

According to Carnoy (*loc. cit.*) amitotic nuclear division in the Arthropods is also met with in the nuclei of the muscle-fibres and in the nuclei of the testicular tubes. Carnoy maintains that in fully-developed muscle-fibres of all Arthropods he invariably observed direct nuclear division only *; from this we can raise no objection against the views represented above, since it is easily conceivable that the nuclei of mature muscle-fibres adapt themselves to their special physiological functions. As regards the nuclei of the testicular tubes, we must naturally strictly distinguish whether the amitotic division occurs in the nuclei of spermatogonia or in those of the supporting- (companion- or fluid-furnishing [Begleit- oder Saft-]) cells which have a secretory function. In the latter amitotic division may be expected; but certain statements exist, according to which it occurs in spermatogonia; these cases must be submitted to fresh investigation. As Dr. vom Rath is at present working at this question in the Zoological Institute here, I will not further discuss it †.

We shall not be surprised to find that amitotic nuclear division occurs in the cells of the fat-body of Arthropods; for these cells, in their physiological function, are adapted to the storing-up of nutritive material, and disintegrate if the nutritive material is used to build up other tissues. Carnoy (*loc. cit.*) describes the amitotic division of the nuclei of cells of the fat-body, and mentions that, in consequence of the absence of cell-division, cells with several nuclei (from two to

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Musca vomitoria," Zool. Jahrbücher, Abt. für Anat. u. Ontog., iii. Bd., 1889.

* With reference to the direct nuclear division observed in the muscle-cells of Vertebrates, Flemming declares (*loc. cit.* p. 290) that it plays no part in the physiological growth of the muscles, and that the amitotic multiplication of nuclei occurring in the pathological regeneration of muscle-fibres has the value of a phenomenon of degeneration. As supplementing this I may further refer to Robert's paper, "Versuche über die Wiederbildung quergestreifter Muskelfasern" (Ziegler's Beiträge zur pathol. Anatomie und allgem. Pathologie, x. Bd., 1891, p. 169), according to which, in the multiplication of cells which give rise to the young muscle-fibres, mitotic division exclusively occurs.

† I refer the reader to the communication from O. vom Rath, which is about to appear in the 'Zool. Anzeiger,' on "The Import of Amitotic Nuclear Division in the Testis" ("Die Bedeutung der amitotischen Kernteilung im Hoden").

ten) are frequently met with *. The consumption of the cells of the fat-body has been minutely observed by van Rees (*loc. cit.* pp. 76–83) in the pupa of *Musca vomitoria*. "It is not only the muscles of the larva," he writes, "which are utilized as food by the leucocytes of the pupa. I have found that the fat-cells also are attacked by them, serve them as food, and are at any rate partially destroyed by them. On the third day I was able, by examining sections, to recognize with certainty the presence of a small number of blood-corpuscles in the interior of these fat-cells. Most of them lay in the immediate neighbourhood of the nucleus, some few in the protoplasmic net of the fat-cell between the small fat-granules. In some blood-corpuscles I found from two to three nuclei, or even six or a still larger number. On the sixth day more than a hundred leucocytes were collected round the nucleus of the fat-cell; the nucleus steadily loses stainable matter, so that the idea naturally arises that the latter is dissolving and is being conveyed to the blood-corpuscles by osmosis. It is not until several days have elapsed that a portion of the fat-cells disappears, and another portion later still. The leucocytes now disperse through the fluid of the body, and we are then able to distinguish, besides leucocytes with only a single nucleus, others which possess several nuclei, even as many as twelve."

Among the Worms, we find in the *Echinorhynchi* a typical example of amitotic nuclear division. According to Hamann's † careful description the nuclei of the dermal layer and those of the lemnisci grow to an enormous size and frequently exhibit branched and lobate forms. Constriction into two equal or unequal parts or resolution into several fragments frequently occur. Since the limits of the cell have disappeared there can be no question of a division of the cell following on division of the nucleus. The function of the nuclei is manifestly that of assimilation; for, as is well known, the *Echinorhynchi* possess no alimentary canal, and are nourished by osmosis through the skin; vacuoles are formed in the dermal layer which coalesce into a lacunar system; the lemnisci, which have arisen as local thickenings of the dermal layer, are traversed by large cavities, which are

* In Vertebrates, too, we find several nuclei in the fat-cells in many kinds of absorption of fat (Flemming, Archiv für mikrosk. Anatomie, Bd. 7, 1871, pp. 71, 330, 357, note; and Virchow's Archiv, 1872). Since the observations in question date from an earlier period, in which no attention was as yet paid to the difference between mitotic and amitotic division, the case in this respect is not yet clear.

† O. Hamann, "Monographie der Acanthocephalen (Echinorhynchen)," Jenaische Zeitschrift, 25 Bd., 1890, pp. 140 and 215.

connected with the lacunæ of the dermal layer of the neck and proboscis. Since the proboscis and the neck are buried in the intestinal wall of the host, and the rest of the body in the lumen of the intestine is surrounded by the contents of the latter, nutrition can be carried on by means of the lacunar system of the proboscis, the neck, and the lemnisci, as well as that of the remainder of the dermal layer. The lacunar system of the lemnisci has, moreover, a hydrodynamic importance for the extension and retraction of the proboscis.

According to Kückenthal * direct nuclear division occurs in the Annelids, in the "lymphoid cells," which float in the body-cavity; many of these cells contain two or four nuclei. Kückenthal considers that the direct division of the nucleus is followed by division of the cell, and he believes that the quadrinuclear cells divide into four uninuclear ones. According to his view the cells which have arisen in this way apply themselves to the dorsal vessel and to the intestine, and change into chloragogen-cells †, which then finally perish by being set free and degenerating. It appears to me that the question of the regeneration of the lymphoid and chloragogen-cells is not yet completely explained by these observations.

In the uterus of Mammals, in the processes which follow the setting-in of pregnancy, especially in the formation of the placenta, amitotic nuclear division occurs in various tissues. We learn from the papers of Masius ‡ and Minot § that in the rabbit fragmentation of the nuclei and multinuclear cells occur in the degenerating uterine epithelium, and that in the endothelium cells of degenerating walls of vessels large fragmented nuclei and peculiar groups of nuclei, pointing to direct nuclear division, are met with. I discuss these phenomena no further, since it would be too difficult and would lead us too far astray to investigate to what extent processes of absorption and secretion are operating in these cases.

The cases of amitotic nuclear division which belong to the domain of the pathologists, especially the nuclear division in

* W. Kückenthal, "Ueber die lymphoiden Zellen der Anneliden," Jen. Zeitschrift f. Naturw. 18 Bd., 1885.

† This statement of Kückenthal's contradicts Vedjovsky's observation ('System und Morphologie der Oligochäten,' Prag, 1884, p. 112), according to which the regeneration of the degenerating chloragogen-cells proceeds from small young cells which lie deep down between the large cells.

‡ J. Masius, "De la Genèse du Placenta chez le lapin," Archives de Biologie, t. ix., 1889.

§ Ch. Sedgwick Minot, "Uterus and Embryo.—I. Rabbit; II. Man," Journal of Morphology, vol. ii., 1889, Boston, Mass.

the giant cells *, which are met with in the spleen, in the marrow of the bones †, and in tumours, I leave entirely on one side.

From all the statements which have been brought forward the reader will have perceived that in the Metazoa amitotic nuclear division only occurs in those cases in which the nuclei have adapted themselves to a special function; it always points to the approaching dissolution of the nuclei. Waldeyer ‡ is of the opinion that the amitotic method of division is the primary one, as being the simpler. The cases which occur in the Metazoa are totally unfitted to support this view; *amitotic nuclear division in the Metazoa always appears as secondarily acquired.* We have yet to discuss the occurrence of amitotic nuclear division among the Protozoa.

Since karyokinesis occurs with such striking agreement in the whole of the animal and the whole of the vegetable kingdom, we may accordingly conclude that this process is phylogenetically a very old one, and was already generally distributed in the common ancestors of animals and plants. In agreement with this is the fact that mitotic division is observed in almost all classes of the Protozoa. Among the Rhizopods it has been clearly established for *Euglypha* §, and among the Heliozoa for *Actinosphærium* ‖; among the Radiolaria, too, it appears not to be absent, for Brandt ¶ has observed in the case of the small nuclei of the Sphærozoids a spindle-shaped transformation during division. Among the Flagellata Bütschli has seen in *Euglena* during the division

* I cannot venture to enter into the discussion of the obscure physiological import of the giant cells; I refer the reader to Flemming's statements (Archiv f. mikr. Anatomie, Bd. 37, p. 292). The occurrence of direct nuclear division and of the formation of giant cells in the marrow of the bones and in tumours has recently been treated of in Straebe's paper, "Ueber Kernteilung und Riesenzellenbildung in Geschwülsten und im Knochenmark," Diss. vorg. d. med. Fakultät zu Freiburg i. B., 1890.

† In many animals (*e. g.* the mouse) the occurrence of giant cells in the spleen and in the marrow of the bones is so regular as to lead us to regard it as the result of a normal rather than of a pathological process.

‡ Waldeyer, "Ueber Karyokinese und ihre Beziehungen zu den Befruchtungsvorgängen," Archiv f. mikrosk. Anatomie, 32 Bd., 1888, p. 44.

§ Schewiakoff, "Ueber die karyokinetische Kernteilung von *Euglypha alveolata*,' Morphol. Jahrbuch, 13 Bd., 1887.

‖ A. Gruber, "Ueber Kernteilungsvorgänge bei einigen Protozoen," Zeitschrift f. wiss. Zoologie, Bd. 38, 1883.—R. Hertwig, "Ueber die Kernteilung bei *Actinosphærium Eichhorni*," Jenaische Zeitschrift, Bd. 17, 1844.

¶ K. Brandt, "Die koloniebildenden Radiolarien (Sphærozoen)," Fauna und Flora des Golfes von Neapel, xiii. Monographie, Berlin, 1885.

of the nucleus "a distinct spindle, with delicate nuclear plate," and he is of the opinion that nuclear division in the Flagellata "in general approaches the so-called indirect nuclear division" *. Among the Ciliate Infusoria the micronuclei always divide with mitosis †.

If we now wish to consider amitotic division in the Protozoa we must first make a strict distinction between those Protozoa which at the same time contain both a macro- and a micronucleus and those in which only a single kind of nucleus is present. In the former the amitotic division of the macronucleus is an established fact, among the latter I know of no case in which amitotic division was incontestably and indubitably proved. As it is only since the commencement of the eighties that Protozoa have been treated by such methods of conservation and staining, that the disposition of the chromatin in the division of the nucleus can be made out ‡, no weight can be attached to any statement of earlier date. I am also unable to attach any great weight to the more recent observation of Brandt (*loc. cit.*), that direct nuclear division occurs in the formation of swarm-spores of Sphærozoids, having regard to the fact that in such small nuclei the chromatin elements and the outline of the spindle are difficult to see, and that in consequence of the smallest imperfections in preparation the former may become clotted together.

If we now turn to the Ciliate Infusoria and the Acinetaria, in which a micronucleus (small or secondary nucleus ["Kleinkern, Nebenkern"]) and a macronucleus (large or primary nucleus ["Grosskern, Hauptkern"]) exist, and consider the morphological properties and the function of the macronucleus, we shall find that between the macronucleus of the Protozoa and the meganucleus of the Metazoa (*cf.* p. 366, note) manifold analogies § exist. The macronucleus

* Bronn's 'Klassen und Ordnungen.—I. Bütschli, Protozoa; II. Abt. Mastigophora,' p. 742.

† In *Opalina ranarum*, in which, so far as we at present know, only a single form of nuclei, and not both kinds, occurs, mitotic division has been distinctly described by Pfitzner ("Zur Kernteilung bei den Protozoen," Morphol. Jahrbuch, Bd. xi.).

As the contour of the nucleus in this instance is always distinct during the mitosis, and consequently by the application of a faulty method of staining the division would appear to be direct, we have the greater right to submit the statements as to direct nuclear division in Protozoa to a severe criticism.

‡ The development of the methods of preserving Protozoa and staining their nuclei is marked by the publications of A. Certes (Compt. Rend. Acad. Sc. Paris, t. lxxxviii., 1879), E. Korschelt (Zool. Anzeiger, no. 109, 1882), Landsberg (Zool. Anzeiger, no. 114, 1882), and A. Gruber (Zeitschr. f. wiss. Zoologie, Bd. 38, 1882).

§ The macro- and meganucleus have arisen in two independent ways.

of the Protozoa is of the greatest importance for nourishment and growth *. It is distinguished by its remarkable size †, and in large Protozoa assumes a branched shape or that of a ribbon or wreath of roses. With regard to the distribution of chromatin it exhibits a certain similarity to the meganuclei of the Metazoa. The process of division may be simply described as direct, or, with reference to the longitudinal streaking and finely fibrillar structure which appears in the dividing nucleus, as an intermediate stage between mitotic and amitotic division. It is very probable that the number of possible divisions is not unlimited, and that, as stated by Bütschli and Maupas (*loc. cit.* p. 400), on the basis of breeding-experiments, conjugation must set in from time to time, when the existing macronucleus undergoes dissolution ‡ and is replaced by one newly formed. As in the Metazoa, so therefore in the Protozoa also, amitotic division appears only in the case of those nuclei which perish after a certain time; it is true that a large number, even several hundreds, of divisions may ensue before regeneration becomes necessary, while among the Metazoa amitotic division indicates the near

We may not speak of an homology, because the Ciliate Infusoria and the Acinetaria must be regarded as terminal branches of the Protozoon stem, which grow no higher; the root of the Metazoa does not proceed from these branches of the Protozoa, and to bring the meganuclei of the Metazoa and the macronuclei of the Protozoa into direct phylogenetic relationship with one another is entirely inadmissible.

* Latterly, following the example of Bütschli, the micronucleus has frequently been distinguished as the sexual nucleus, and the macronucleus as the metabolism-nucleus (*vide* Bütschli, 'Protozoa, III. Abt. Infusoria,' p. 1643). Compare also the statements of R. Hertwig, "Ueber die Konjugation der Infusorien," Abhandl. d. k. Akademie, München, II. Kl. 17 Bd., 1889, p. 216 *et seqq.*

† Maupas ("Le rajeunissement caryogamique chez les ciliés," Archives de Zoologie, exp. et gén. 2 sér. t. vii., 1889, x. p. 444) writes:—"An extremely important consequence results from the growth of the new macronuclei. These nuclei in point of fact lose the faculty of dividing by karyomitosis, and henceforward only multiply by simple constriction. At the same time their function, having become purely vegetative, will be confined to the control of nutrition, growth, and agamic multiplication. They have entirely lost the faculty of rejuvenating caryogamy."

‡ Maupas (*loc. cit.* p. 446), writes:—"The mode of eliminating the old nucleus differs slightly according to the species. In *Colpidium* . . . . the whole becomes disorganized at once, and gradually dissolves by a slow absorption, resembling actual digestion. In the Oxytrichidæ, Loxophyllidæ, Euplotidæ, and Vorticellidæ this absorption is preceded by a fragmentation; lastly, in the two large *Paramecia* preparation is made for the fragmentation itself by a preliminary unrolling of the nuclear mass, which becomes drawn out into long ribbons." A detailed description of the dissolution of the macronucleus will be found in Bütschli, *loc. cit.* p. 1613.

approach of the end of the divisions; nevertheless it must at the same time be remarked that the amitotic division of the macronucleus runs a more regular course and stands much nearer to mitotic division than the typical cases of amitotic division which occur in the Metazoa.

It would not be quite correct simply to assert that in the Protozoa direct nuclear division is followed by division of the cell, because before a ciliated Infusorian or an Acinetarian divides a double nuclear division takes place—the direct division of the macronucleus and the indirect of the micronucleus *.

It follows from what has been stated that also in Protozoa amitotic division, in so far as we know it at present, is seen not as the primeval method, but as that which is of secondary origin. We have therefore now no empirical ground for the view that indirect nuclear division has originated phylogenetically from direct. The question as to the earliest origin of mitosis leads to that of the earliest origin of the nucleus, and is equally obscure.

Freiburg i. B., Zoological Institute of the University,
April 1891.

Postscript.

A short time before I received the proof-sheets of this paper there appeared M. Loewit's treatise on "Regeneration and Constitution of the White Blood-corpuscles" ("Neubildung und Beschaffenheit der weissen Blutkörperchen," Ziegler's Beiträge zur pathol. Anatomie und allg. Pathologie, 10 Bd., 1891, p. 213), in which it is stated that the cells which float in the blood of the crayfish always exhibit amitotic nuclear division; this nuclear division is frequently followed by division of the cell, but multinuclear cells also occur. It appears to me that no objection can be derived from these observations against the statements which I have made above: for, in the first place, Loewit himself gives a detailed description of the secretory nature of the cells of the crayfish's blood; he mentions that "in the cell-body of numerous cells of the crayfish's blood in the fresh state glistening drop-like structures of varying form and size, and resembling fat, are

* Since in many Acinetaria, and especially in the swarm-spores of *Podophrya*, micronuclei have been shown to exist (*vide* Bütschli, *loc. cit.* p. 1873; Maupas, *loc. cit.* p. 385), the well-known constricting-off of the nucleus in the formation of the swarm-spores of *Podophrya* simply represents the division of the macronucleus.

contained;" he terms the blood-corpuscles simply "unicellular movable glands," and, with reference to the chemical nature of the secretion, "globulin-containing albumen-glands." In the second place, so far as can be judged from his publication, Loewit only examined the blood which flowed from a wound on the body or which was drawn up from between the organs by a pipette; it is consequently a permissible hypothesis that centres for the regeneration of blood-corpuscles exist in the crayfish as in the Insects (see p. 213 of this volume of the 'Biologisches Centralblatt'), which, from a physiological standpoint, would be comparable to the lymphatic glands of Vertebrates, and in which the division of the cells may take place by mitosis. If this is the case it does not appear remarkable that amitotic nuclear division occurs in the blood-corpuscles circulating in the body, which, indeed, have an assimilating and a secretory function. A short time ago Cuénot (Archives de Zoologie, exp. et gén. 2e série, t. ix., 1891, pp. 78 and 83) observed in the crayfish in the gills and in the neighbourhood of the heart "glandes lymphatiques," which he regards as the centres for the regeneration of the blood-corpuscles. I believe therefore that it has not been conclusively proved by Loewit's investigations that a "regenerative" amitotic nuclear division exists. I may incidentally remark that Dr. vom Rath has shown me a series of sections of a young fish-louse (*Cymothoa*, sp., from Naples, 5 millim. long), in which mitotic division of blood-corpuscles was abundantly visible.

XLIX.—*On new Species of* Histeridæ. By George Lewis.

This paper is the seventh of a series published in this Magazine on the Histeridæ, and in the fifth memoir, that of June 1885, the estimate of known species was given as 1485, which included those given in the Munich Catalogue and in Schmidt's List of 1884. Since this assessment was made nearly 450 species have been noticed by various authors; but these figures include those of this paper and 16 of a paper in the press recording new species from Burmah, and do not note any reduction in the general number which may have arisen through the adjustment of the synonymy. Taking the total, then, as it stands now at 1850 species, it cannot be said, as regards their present numbers, that the Histeridæ are a very important family in the Coleoptera; but there are several

large collections in Europe containing material which is not yet worked out, and these must contain a very considerable number of new species, while beyond this nearly every collector who visits places outside the European limit discovers species to be added to our lists. Even those whose rambles merely extend to the Algerian border of the Mediterranean bring home novelties.

The family will probably ultimately rank with the Nitidulidæ and Colydiidæ, families in which the more curious species require of a collector a careful study of various insect-habits, as most of them are entomophagous or commensal ; and these habits lead to many-sided instincts which go hand in hand with an intricacy of structure and a refinement of colour which makes the acquisition of a new species, possessed of such characteristics, a most attractive element in the popular side of entomology.

List of Species arranged generically.

Apobletes Duvivieri.
—— Semperi.
—— platysomoides.
—— corticalis.
—— semirufus.
Platysoma solitarium.
—— constrictum.
Liopygus, n. gen.
Pachycrærus violaceipennis.
Hister recurvus, *Mars.*
—— Sikoræ.
Epierus dux.
—— imitans.
Baconia festiva.
Carcinops dulcis.
Paratropus manicatus.
—— castaneus.
—— effertus.
—— dædalus.
—— anthracinus.
Eretmotus carinatus.
Triballus corylophioides.
Saprinus flavipennis, *Péringuey.*
Saprinodes, n. gen.
—— falcifer.
Teretriosoma viridicatum.
—— cingulum.
—— nigrescens.
—— Grouvellei.
—— plumicornis.
—— pilicornis.
Trypanæus rostratus.
—— plagiatus.
—— fasciatus.
Trypeticus Grouvellei, *Mars.*
—— obeliscus.
—— minutulus.
Onthophilus punctisternum.
—— bipartitus, *Lew.*
Colonides parvulus.

Apobletes Duvivieri, sp. n.

Oblongo-ovatus, complanatus, nigro-piceus, nitidus ; fronte leviter impressa, stria recta utrinque interrupta ; pronoto stria interna antice interrupta, interstitiis angustatis ; elytris stria 1ª integra, 2ª basi abbreviata, 3ª brevissima.

L. $5\frac{3}{4}$ mill.

Oblong-oval, parallel at the sides, flat ; head smooth, lightly impressed anteriorly, frontal stria straight, not finely impressed, interrupted at each side, bent over the eyes ; thorax impunc-

tate, marginal stria fine, internal parallel to it, both ceasing behind the eye, interstice narrow, the scutellar spot is a small clear puncture; elytra, striæ all well impressed, first complete, second parallel to it but abbreviated at the base for about one fifth, third basal but as long as one third of the wing-case and passing well beyond the abbreviation of the second, there is also an apical appendage to it of one or two punctures; propygidium polished, with a cluster of punctures placed transversely on each side; pygidium, posterior margin narrowly raised and smooth, the surface within is covered with large punctures evenly and rather closely set; prosternum is without sculpture or sparsely punctulate under the microscope; mesosternum shortly bisinuous and a little impressed behind the base of the prosternum, and there is a short transverse stria at each angle; anterior tibiæ 4-dentate.

Hab. Itembo, Central Congo (*Duvivier*).

Apobletes Semperi, sp. n.

Oblongo-ovatus, depressus, piceus, nitidus; elytris striis 1^a–3^m validis, integris, 4^a apicali; pygidio ocellato-punctato.
L. 4 mill.

Oblong-ovate, depressed, pitchy red, shining; head concave in front, with rather a strong and straight stria, a little shortened on each side, mandibles punctulate; thorax smooth, stria strong at the sides and at anterior angle, but terminating behind the eye, the lateral interstice is nearly the same width throughout; elytra, striæ 1–3 entire, rather strongly impressed, and nearly straight, 4 short, apical, and clearly defined; propygidium wholly punctate, punctures irregularly ocellate, shallowly impressed on either side; pygidium somewhat triangular, punctures ocellate and closely set, no marginal border; the prosternum is smooth; mesosternum sinuous anteriorly, stria well marked and continuing down the sides of the metasternum, anterior margin narrow; metasternal median line faint; legs and tarsi reddish, anterior tibiæ 4-dentate, intermediate 4-denticulate.

Hab. Philippine Islands (*G. Semper*).

Apobletes platysomoides, sp. n.

Oblongo-ovatus, depressus, niger, nitidus; elytrisstriis 1^a-2^a integris, 3^a subinterrupta, 4^a apicali; pygidio punctato, anguste marginato.
L. $4\frac{1}{2}$ mill.

Oblong-ovate, depressed, black, shining; head concave in

front, very finely punctulate throughout, stria rather fine, very feebly sinuous, shortened or interrupted at the eye and strongly impressed over it, mandibles punctulate; thorax also with an extremely fine punctuation, stria strong at the sides and ending behind the eye, the interstice is not wide, but differs from the last species in widening out a little before the middle; before the scutellum is a short, very fine line; elytra, striæ 1–2 entire, nearly straight, 3 evanescent or a little interrupted in the middle, 4 short and apical; propygidium transversely punctate, punctures shallow, irregular, and somewhat oval, the posterior margin smooth; pygidium more closely set with similar punctures, margin narrowly smooth and feebly raised, the pygidium more transverse than in *A. Semperi*; prosternal keel without striæ, but appears a little opaque, owing to an extremely fine punctuation, so also are the other sternal plates; the mesosternum is sinuous in front, stria complete and well marked, margin narrow, as in the last species; metasternal median line fine; legs and tarsi piceous, tibiæ as in *A. Semperi*.

Hab. Tenasserim (Victoria Point).

Apobletes corticalis, sp. n.

Oblongo-ovatus, ferrugineus, complanatus, nitidus; elytris striis 1ª–2ª integris, 2ª sinuata, 3ª late interrupta; mesosterno bisinuato, antice in medio minute producto, stria late interrupta.

L. 3 mill.

Oblong-ovate, ferruginous, flat, and shining; head nearly smooth, frontal stria complete, transversely a little bent; thorax, stria interrupted behind the neck, with a longitudinal patch of punctures on each side before the middle a little distance away from the margin, there are some strigous punctures also near the posterior angle; elytra, first and second striæ complete, first straight, second a little bent, third widely interrupted in the middle, apical portion shortest; propygidium lightly bifoveolate, punctate throughout, punctures largest and confluent at the sides; pygidium closely punctate, with the hinder margin raised on each side, with apex depressed; prosternum feebly emarginate at the base, smooth; mesosternum anteriorly bisinuous and a little produced in the middle, striate at the sides only, stria ceasing where the prosternum touches; metasternum with a lateral stria, which is hooked inwards anteriorly and does not join the mesosternal stria; anterior tibiæ 4-dentate.

This species in colour and outline resembles *Liopygus diop-*

sipygus, Mars., for which Marseul's measurement is 3 millim.; but this only measures $2\frac{1}{2}$ millim.

Hab. Perak, low country (*Doherty*).

Apobletes semirufus, sp. n.

Oblongo-ovatus, complanatus, subtus piceus; elytris rufis, striis 1^a–3^m integris, 4^a basi abbreviata, 5^a apicali; prosterno bistriato; pygidio punctulato; pedibus rufis.

L. $1\frac{3}{4}$–2 mill.

Oblong-ovate, flat, piceous beneath, head and thorax (except the margins) above black, elytra red, propygidium and pygidium reddish brown; head flat, finely punctured, punctures not dense, striate above the eyes only; thorax somewhat transverse, feebly and sparsely punctulate at the sides, lateral stria fine and anteriorly ceasing behind the eye, at the base it continues round the angle as far as the first elytral stria, and behind each eye, a little distant from the margin, is a short bent stria; elytral striæ fine and feebly punctate-striate, first to third complete, fourth evanescent at the base, fifth short and apical; propygidium and pygidium finely, not densely, punctate, the latter with a slight impression on each side at the base; prosternum bistriate, striæ from the coxæ widening out towards the anterior lobe, lobe clearly punctate; mesosternum transverse, bisinuate, stria complete, but very close to the margin behind the prosternal keel, more clearly visible and stronger at the anterior angles; the anterior tibiæ have four or five blunt teeth.

Hab. Bahia.

Platysoma solitarium, sp. n.

Ovatum, convexiusculum, nigrum, nitidum; fronte haud excavata; elytris striis validis, 1^a–3^m integris, 4^a–5^a dimidiatis; prosterno angustato, lobo marginato; pygidio punctato.

L. 3 mill.

Oval, rather convex, black, shining; head and clypeus scarcely impressed, impunctate, stria complete, transversely fine and nearly straight; pronotum smooth, stria fine and complete, lateral margin narrow and same width throughout, sides of thorax gradually turn inwards from the base, anterior angles robust; elytra, striæ well marked and all equally impressed, 1–3 complete, 4–5 almost equal, apical, and reaching to the middle; the fifth is rather further from the suture than from the fourth; propygidium and pygidium a little

coarsely and somewhat closely punctured, the posterior margin of the latter is not raised; prosternum, keel very narrow, widening out elliptically between the coxæ, where it is margined with a stria, anterior lobe feebly punctulate, with a clear marginal stria anteriorly; mesosternum rather deeply cut out to receive the base of the prosternum, the marginal stria complete and well-marked, leaving a fairly wide margin anteriorly, except at the incision, where it is extremely narrow and feebly sinuous; the anterior tibiæ are 4–5-dentate.

Hab. Borneo (*Doherty*).

Note.—*Platysoma elingue*, Lew.—The prosternal keel is narrow in this species and without sculpture, the anterior lobe is margined with a stria and visibly punctate, the mesosternum is emarginate, not incised as in *solitarium*, and the stria is sinuous.

Platysoma constrictum, sp. n.

Oblongum, subparallelum, parum depressum, nigrum, nitidum; elytris striis 1^a–3^m integris, rectis, 4^a apicali; prosterno antice constricto; pygidio punctato.

L. $3\frac{1}{4}$ mill.

Oblong, rather parallel at the sides, a little depressed, black, legs reddish; head lightly impressed in front, obscurely punctulate, stria rather fine, equally clear transversely as over the eye; thorax impunctate, stria complete, anterior angles rather abruptly turned in from a point agreeing with the line of the neck; elytra with three complete outer striæ well marked and nearly straight, fourth straight and apical, occupying about one third of the elytron, apices impunctate; propygidium and pygidium evenly but not closely punctured; the prosternal keel is very remarkable, and is limited almost to the region of the coxæ; between the coxæ it is smooth and without striæ, in front of the coxæ it is constricted and abruptly depressed, and is gradually flattened out and merged in the lobe; mesosternum rather widely emarginate, with the angles on each side a little prominent, stria complete; anterior tibiæ 4-dentate. All the sternal plates are impunctate.

This species is narrower and more parallel than *P. dufali*, Mars., but in its general outline it somewhat resembles it.

Hab. N.W. Australia.

Liopygus, gen. nov.

There are certain species which until now have been indis-

criminately placed in *Apobletes* and *Platysoma*, which have an almost impunctate pygidium, with two large and deep excavations in the base near the outer edge. With this exception the general characters of these species agree with *Platysoma*; but I think it is now time to separate them, and I propose to adopt *Liopygus* as a generic name for them. I include in it *decemstriatus*, Mots., *cavatus*, Lew., *exiguum*, Lew., *famelicus*, Lew., *Gestroi*, Lew., and *diopsipygus*, Mars.

Pachycrœrus violaceipennis, sp. n.

Oblongo-ovatus, niger, elytris subviolaceis; fronte bistriata, striis lævissime impressis; mesosterno parum acute producto, antice immarginato.

L. 4 mill.

Oblong-oval, black, shining, elytra with a violet tinge; forehead and clypeus widely excavated and sparsely punctulate, stria well marked over and in front of the eyes, but after passing the base of the mandibles it splits into two and becomes very fine, the anterior branch taking a semicircular course, and the posterior branch bending in the middle in the reverse direction towards the neck; thorax punctulate on the disk, punctures at the sides larger and more closely set, anterior angles a little deflexed and a little acutely produced, with an impression within the angle, marginal stria complete; elytra, striæ 1–3 complete, fourth shortened at the base, fifth nearly one third the length of the elytron, sutural reaching, and widening out a little at the scutellum, and apically the interstice is slightly narrowed; propygidium rather closely punctured, punctures on pygidium more dense; prosternum, keel flat, with lateral striæ fine and parallel before the coxæ, and widening out a little at the base, surface sparsely punctulate; mesosternum somewhat acutely produced anteriorly, with a fine oblique stria at the sides only; the stria is common to the metasternum also. The mesosternum and first segment of the abdomen punctulate like the prosternum, but the metasternum is nearly smooth.

The frontal striæ are a remarkable characteristic in this insect.

Hab. Itembo, Central Congo (*Duvivier*).

Hister recurvus, Mars.

This species is a maculate one; it has two large lobe-like red spots at the base of the thorax, well separated from each

other by a black area in front of the scutellum. Marseul did not observe this, as the type, which I possess, is stained by immersion in spirit; but on a close examination of it I can see that it possesses these red blotches. There are also two large red blotches on the metasternum, one on each side at the widest part.

Hister Sikoræ, sp. n.

Breviter ovalis, niger, nitidus; pronoto stria interna integra, postice flexuosa, externa utrinque abbreviata; elytris striis 1^a–4^m integris, 5^a suturalique brevibus.

L. $6\frac{1}{2}$ mill.

Short-oval, black, shining; head feebly punctulate and rather wide, stria well marked and semicircular; thorax smooth, with a small scutellar point on the thoracic edge, inner stria complete, flexuous towards the base, hamate at the angle, interstice broad for two thirds the length from the anterior angle, then it narrows down to the point where the outer stria ceases; external stria ceases behind the eye and before the base; elytra, striæ 1–4 complete, 3–4 sinuous, leaving a wide interstice at the base between the second and third, fifth apical, short and anteriorly punctiform, sutural widely shortened at the base, punctiform at the apex; propygidium clearly but not closely punctate, pygidium similarly punctured at the base, the punctures gradually becoming smaller at the apex; prosternum narrowed before the coxæ, and without sculpture; mesosternum subsinuous in front, stria complete but rather fine, it is not connected with the metasternal lateral stria, the last, although commencing at the anterior suture, begins nearer the middle; anterior tibiæ 3-dentate, the others multispinous.

This is the largest species of the genus from Madagascar at present known, and the trivial name will help to commemorate Mr. F. Sikora's sojourn in this delightful island.

Hab. Madagascar (east coast).

Epierus dux, sp. n.

Ovalis, convexus, niger, nitidus; elytris striis 1^a–3^m integris et cæteris abbreviatis, apicibus rugoso-punctatis; propygidio pygidioque dense et grosse punctatis.

L. $4\frac{1}{2}$–$4\frac{3}{4}$ mill.

Oval, convex, black and shining; forehead finely punctulate, flattish between the antennæ, sulcate over each eye;

the labrum straight in front; thorax, stria complete, finely crenulate behind the head, distinctly punctulate at the sides, punctures becoming evanescent on the disk; a scutellar impression is finely punctulate; elytra have three outer striæ crenulate and complete, the first and second are strongest in the middle, fourth apical, ceasing in the middle, with a cuneiform appendage at the base, the fifth is shorter, with a simple puncture at the base, the sixth is longer and punctiform anteriorly; the apices of the elytra are rugosely punctate, after the manner of *Sternaulax Edwardsi*, but less coarse; propygidium and pygidium densely and coarsely punctured; prosternum, keel finely, not closely punctulate, with a stria on each side terminating close on the base, feebly sinuate before the coxæ, and nearly meeting in front; mesosternum feebly sinuous behind the prosternal keel, and margined anteriorly with a crenulate stria; anterior tibiæ 7–10-dentate, posterior spinose.

It is singular to see this species agreeing with the *Sternaulax* in the sculpture of the elytra, as both species were apparently taken together.

Hab. Madagascar (east coast).

Epierus imitans, sp. n.

Oblongo-ovalis, convexus, niger, nitidus; elytris striis 1^a–3^m integris, 4^a–5^a brevibus, 6^a basi late abbreviata; propygidio pygidioque parum dense punctatis.

L. $3\frac{1}{4}$–$3\frac{1}{2}$ mill.

Oblong-oval, convex, black; forehead nearly smooth, with a strong stria over the eyes; head impressed between them, labrum widely emarginate; thorax, stria complete, finely crenulate behind the head, punctulate at the sides, punctures on the disk scarcely visible; scutellar spot somewhat linear; elytra, striæ 1–3 complete and feebly crenulate, 4–5 equal, or fourth one third and fifth one quarter the length of the elytron (varying in all examples); fourth has a short basal appendage, fifth a puncture, sixth apical and two thirds as long as elytra, apices irregularly and not very distinctly punctulate; pygidium and propygidium a little closely punctured; prosternum, keel punctures scarcely visible, stria as in *E. dux*, but less sinuous and joining anteriorly; mesosternum sculptured similarly to that of *E. dux*, but less wide; anterior tibiæ 6–7-dentate.

Hab. Madagascar (east coast).

Baconia festiva, sp. n.

Breviter ovalis, depressa, viridis, pedibus obscure rufis; fronte distincte punctata; elytris striis 1^a–3^m integris, 4^a–5^m abbreviatis; prosterno lato, bistriato; mesosterno haud sinuato, antice immarginato, stria transversa arcuatim impressa; tibiis anticis tridentatis.
L. 2 mill.

Depressed, shortly ovate, metallic bluish-green above, legs dull red; head clearly but a little sparsely punctate, obscurely striate above the eyes; thorax punctured at the sides like the head, smooth in the middle, external stria fine but complete, anterior angles distinctly reflexed; elytra, striæ 1–3 complete, feebly punctate, third finer apically, fourth fine at the apex, becoming punctiform towards the middle and evanescent at the base, fifth short, fine, punctiform, apical, and terminating before the middle, no sutural, apical margin sparsely punctulate; propygidium and pygidium punctured like the head, the pygidium is transverse and somewhat parallel at the sides; prosternum, lobe punctate, keel flat, smooth, rather wide, bordered laterally with two strong and nearly straight striæ; mesosternum transverse, broad, and very short, anteriorly nearly straight, but slightly receding from the prosternum, transverse stria well marked and feebly bowed; anterior tibiæ with three teeth well separated from each other, posterior unarmed.

This species corresponds structurally with *B. loricata*, Lew. It is not similar to *Phelister micans* and *fulgidus*, Sch., in both of which the mesosternum is anteriorly bisinuous. The mesosternum is similar to that in a *Carcinops*, and I am not at all sure at this stage of the study of the genus that it may not eventually be placed nearer to *Carcinops* than *Phelister*.

Hab. Bahia.

Carcinops dulcis, sp. n.

Oblonga, subparallela, parum convexa, nigra, nitida; fronte stria semicirculari completa; thorace punctulato, in media linea impressa; elytris striis punctato-striatis; pygidio rugoso-punctato; mesosterno metasternoque utrinque fortiter striatis.
L. $1\frac{1}{4}$–$1\frac{1}{2}$ mill.

Oblong, somewhat parallel at the sides, moderately convex, black, shining; head a little convex, finely and sparsely punctulate, stria clear, complete, and semicircular, clypeus short; thorax, anterior angles depressed, stria fine and complete, punctulate throughout, but not densely; a faint line before

the scutellum is half the length of the thorax; elytra, striæ 1–3 are punctate and complete, the fourth is punctiform apically, fifth punctiform and evanescent at base, sixth as last but only reaching the middle; in the dorsal region of the suture there is a fine stria, not punctate, which may or may not be the true sutural; propygidium and pygidium rugosely punctate, especially the latter; prosternum bistriate; mesosternum deeply emarginate in front, and the transverse stria following the emargination is fine, but at the sides it is very strong, slightly sinuous, and ceasing only at the posterior edge of the metasternum; the first segment of the abdomen has a somewhat similar lateral stria and a shorter one outside of it; the external edge of the intermediate tibia is armed with a tooth similar to that in *C. striatisternum*, Lew., to which species it has a close resemblance; the anterior tibiæ have four evenly placed teeth.

In *Carcinops striatisternum* the metasternal lateral stria does not connect with the mesosternal line, but it has a second shorter stria outside of and parallel to it; both this and *C. dulcis* are without the conspicuous emargination in the outer edge of the anterior tibiæ, and it is with some doubt I leave them in *Carcinops*.

Hab. Sumatra.

PARATROPUS, Gerstäcker.

In the Munich Catalogue Harold gave Marseul's genus *Phylloscelis*, 1862, the preference over Gerstäcker's *Paratropus*, 1866; but *Phylloscelis* was used in the Homoptera by Germar in 1839.

Paratropus manicatus, sp. n.

Orbicularis, supra convexus, brunneus; clypeo impresso; pronoto stria laterali integra, antice haud striato; elytris punctulatis, striis nullis; pygidio lævi; mesosterno immarginato.

L. $1\frac{1}{2}$ mill.

Orbicular, rather convex, brown, and shining; head very obscurely punctulate, clypeus longitudinally impressed; thorax, lateral stria fine but clear, margin narrowly and slightly raised, anterior angles obtusely produced, no anterior stria, punctured throughout, punctures very fine, most visible before the scutellum, obscurely strigose at the sides; elytra finely and a little closely punctulate, marginal stria very clear and complete; the dorsal striæ are obsolete and the disk inclined to be black; propygidium and pygidium nearly smooth; pro-

sternum broad and widening out anteriorly, lateral stria very fine, nearly smooth, widely incised at the base, edge of the anterior lobe somewhat reflexed; mesosternum widely produced in front, without marginal stria, obscurely punctulate; metasternum with an extremely fine oblique stria on each side, distinctly and rather closely punctulate, except at the middle of basal region; first segment of abdomen bistriate at sides and more finely punctulate; tibiæ dilated and without teeth, the intermediate and posterior being obtusely angulate in the middle of the outer edge.

This species resembles *P. castaneus* in size, colour, and shape.

Hab. Mexico.

Paratropus castaneus, sp. n.

Orbicularis, supra convexus, brunneus, nitidus; fronte ante oculos carinata; thorace elytrisque sparsissime punctatis; prosterno utrinque bistriato; mesosterno in medio punctato.

L. $1\frac{1}{3}$ mill.

Nearly circular in outline, brown, shining, convex above; head polished, with six or eight punctures bearing setæ on the forehead, carinate before the eyes, impressed anteriorly, clypeus a little constricted at base; thorax, marginal stria fine and clearly visible at the sides, interstice narrow, an oblique impression begins behind the eye and terminates before the posterior angle, and has an extremely fine bent stria in its centre; the disk has widely scattered punctures, each bearing a seta; elytra, marginal stria fine, very clear, and complete, the dorsal striæ are represented by punctures bearing setæ similar to the thorax, except that those in the position usual to the first three striæ are in rows; propygidium and pygidium nearly smooth, a few flavous setæ are visible on the surfaces; prosternum impunctate, triangularly incised at the base, the keel wide, with two striæ on each side, both widening out anteriorly from the base; the mesosternum triangularly produced in front, the apex being feebly reflexed; anteriorly the mesosternum is immarginate, but there are three very fine striæ on each side, which are apparently "lateral striæ;" they all start from a common point opposite the exterior stria of the prosternal keel, and they are continued down the side of the metasternum; mesosternum with a few scattered and feebly impressed punctures in the middle; the first segment of the abdomen has a row of punctures on the anterior edge and is bistriate laterally.

Hab. Mexico.

Paratropus effertus, sp. n.

Ovalis, convexus, nigro-piceus, nitidus; elytris stria 1ª integra, 2ª brevi et obliqua, suturali utrinque abbreviata; pedibus rufo-brunneis.

L. $1\frac{3}{4}$ mill.

Oval, convex, nearly black, shining, smooth; head flat, lateral stria continuous down the sides of epistoma, latter rather broad; thorax transverse, broad at the base, anterior angles not projecting, marginal stria fine and complete, no interstice, along the edge of the base are a few distinct punctures; elytra, the first stria is faint but complete, and passes round the apices to the suture, second short and oblique, sutural dorsal, widely interrupted at both ends; the propygidium is clearly, not closely punctured, except behind, which is, with the pygidium, nearly smooth; prosternum rather wide, with a very short, transverse, anterior lobe, arched at the base, striate on the sides, the base is triangular, margined behind and at the sides, the keel is feebly canaliculate in the middle before the coxæ, with two striæ on each side parallel to the canaliculation; the mesosternum is bisinuous in front and very clearly margined, and the metasternum is smooth, without any visible dividing suture, but there are two lateral striæ common to it and the mesosternum, the inner stria being shortest and oblique, the outer one is bent and posteriorly passes along the edge of the femoral cavity; the tibiæ are widely dilated, but are not angulate on the outer edge.

Viewed from above this species resembles a small *Eretmotus*; but the angles of its thorax are not produced. The useful characters for the recognition of the species lie in the sterna.

Hab. Bahia.

Paratropus dædalus, sp. n.

Ovalis, convexus, opacus, niger, pedibus rufo-piceis; pronoto dense strigoso; elytris stria 1ª integra, cæteris nullis; tibiis valide dilatatis.

L. 2 mill.

Oval, convex, black, and opaque, densely strigose or punctured above; head flat and strigose, epistoma concave, striate above the eyes; thorax transverse, with the anterior angles very blunt, lateral striæ extremely fine, the anterior portion and sides are densely strigose, the striæ are longitudinal and gradually break up into punctures on the disk before the scutellum; elytra densely sculptured, but much less evenly

strigose, with acicular punctures near the suture, on the outer margin there is one complete, very distinct stria, and in the dorsal region near the suture there are longitudinal uneven masses, which correspond probably to sutural striæ; propygidium and pygidium densely punctured, punctures resembling those on the apices of the elytra; the prosternum is wholly and densely covered with acicular punctures, the margin of the anterior lobe is without a stria, the striæ on the keel are raised into carinæ, not separated widely and nearly straight, but joining anteriorly, the median area is rugosely punctured and the base incised; mesosternum transverse, produced in the centre, covered, not densely, with rather large irregular punctures; metasternum laterally bistriate, inner stria nearly straight, punctures more scattered than on the mesosternum and distinctly acicular; the first segment of the abdomen has similar punctures more densely set and somewhat similar lateral striæ; the tibiæ are all widely dilated and angulate on the outer edge, and the fore tibiæ are armed with three teeth on the outside of the tarsal groove.

Hab. Bahia.

Paratropus anthracinus, sp. n.

Ovalis, parum convexus, niger, nitidissimus; pronoto in medio transversim striato; elytris striis 1^a–3^m integris, 4^a antice hamata, suturali crenulata; propygidio postice prominulo; tibiis modice dilatatis.

L. $1\frac{1}{2}$ mill.

Oval, rather convex, jet-black, and shining; head impunctate, the epistoma is margined by two conspicuous carinæ, which, viewed from above, give an outline like two small tubercles; thorax dilated at the sides as in *Hetærius brunneipennis*, the lateral sulcus is short, ending in a fovea well before the base, the fovea being connected with the corresponding fovea on the other side by a fine bow-shaped stria which traverses the median area of the thorax, behind this stria are ten punctures, five on each side, equidistant from one another; elytra, the striæ are fine and clearly cut, first to third complete, first turning obliquely towards the second at the base, second and third bent, but parallel to each other, fourth widely crenulate apically, and anteriorly well before the base it is incurved (or hooked) towards the suture, the sutural stria is composed of wide irregular crenulations; the propygidium is transverse, with obtusely angulate posterior corners, viewed sideways the posterior edge is seen to be built up in a most remarkable way, projecting beyond the pygidium; the

pygidium is convex and smooth; the prosternum is without sculpture, and the keel and the anterior lobe are narrowly built up to the level of the mesosternum, and the keel is very slightly narrowed in the middle and a little widened out at the base, the anterior lobe, which is not distinct from the keel, is narrower than the base of the prosternum; the mesosternum and metasternum are longitudinally convex and consist of one plate, smooth, with an anterior stria, which leaves a wide interstice in front and passes at right angles down the sides and crosses the first segment of the abdomen; outside this stria is a second, which commences at the intermediate coxæ and runs parallel to it; these lateral striæ are very strong; the first segment of the abdomen is punctate on each side at the anterior edge, and in the middle there is a tubercle which is partly abdominal and partly metasternal; the tibiæ are moderately dilated, feebly angulate on the outer edge, and a few small spines are seen on the anterior pair.

This curious species is placed in *Paratropus* provisionally; superficially, owing to the shape of the thorax, it looks like an *Hetærius*. The anterior lobe of the prosternum is narrower than the base of the keel.

Hab. Bahia.

Eretmotus carinatus, sp. n.

Orbicularis, convexus, niger, subnitidus; fronte stria carinata punctulata; elytris striis marginalibus carinatis, stria 1ª subintegra, 2ª dimidiata, 3ª abbreviata; propygidio vix dense punctato; pedibus rufis.

L. $2\frac{1}{8}$ mill.

Orbicular, convex, black, not very shining; head rather densely punctulate, with an extremely fine sculpture between the punctures, which gives an appearance of opacity; the lateral striæ are carinate, not meeting in front, but passing down the sides of the clypeus; thorax closely but not densely punctulate on the disk, punctures at the sides and behind the neck closer and subocellate (but shallow) under microscopic power; well within the posterior angle is a triangular sulcus, apex pointed outwards; the anterior angles are very obtuse and slightly reflexed, the lateral stria is complete and just before the posterior angle it widens out a little and leaves on the margin a minute longitudinal fissure, angle reddish; elytra, the first stria evanescent apically, second dimidiate, third less distinct, the first and second are carinate for the basal half, and the marginal stria, with the short subhumeral one which joins it, is also carinate; prosternum rugosely punctate,

lateral stria short and obscure, beginning before the coxæ only and ending before the transverse suture, which is well marked; the anterior lobe is short and transverse; mesosternum bisinuate anteriorly and margined with a stria; propygidium and pygidium rather densely punctured.

Eretmotus has two claws on each tarsus.

Hab. Saïda, Algeria (*Baron Bonnaire*).

Triballus corylophioides, sp. n.

Circularis, supra convexus, piceus, nitidus; pronoto elytrisque lateralibus striatis; prosterno bistriato; antennis pedibusque rufis.
L. $1\frac{2}{3}$ mill.

Circular in outline, convex above, piceous, shining; forehead slightly convex, clypeus short and obtuse; thorax, lateral stria well marked, ceasing at the anterior angle, and sinuous in the middle; elytra with a stria similar to that of the thorax at the sides, no dorsal stria; the whole of the upper surface appears finely punctulate under strong microscopic power, but there is no other sculpture; prosternum broad, with a fine and short stria on each side near the coxæ; before the anterior lobe is a feeble but distinct transverse ridge, and the edge of the lobe is narrowly reflexed; the meso- and metasternum and the first segment of the abdomen are without striæ; the mesosternum is anteriorly nearly straight; legs reddish, tibiæ a little dilated before the tarsi, edges without spines.

This species in the almost total absence of sculpture resembles an *Idolia*.

Hab. Sumatra.

Saprinus flavipennis, Péringuey.

The type of this has been kindly sent to me by Mr. L. Péringuey, and I find it does not differ from *cruciatus*, F. It is a European species, which occurs also as far south as the Transvaal.

Saprinodes, gen. nov.

I propose this genus to receive a curious species from Queensland; it differs from *Saprinus* in having slender falciform anterior tibiæ, narrowed at either end, and in having two thirds of their length grooved for the reception of the tarsi. The anterior tibia also is carried on beyond the point where the tarsi are inserted, and terminates in a very conspicuous hook. The body is not very convex and the legs are longer than in *Saprinus*, while the prosternal cavities in

which the clubs of the antennæ rest are larger and more in the keel, and are apparently the cause of the constriction in it. When viewed sideways the partition in the keel between the two cavities is so slight that light may be seen through it.

Saprinodes falcifer, sp. n.

Ovalis, convexiusculus, æneus, nitidus; elytris dense strigoso-punctatis, speculo scutellari nitido rotundo; tibiis anticis hamatis.
L. $3\frac{1}{2}$ mill.

Oval, brassy, but little convex, punctured wholly above, except five smooth disks on the thorax and two round disks near the base of the elytra which touch the sutural striæ; the frontal stria ceases at the antennæ; the elytral disks are clearly defined, as in *Saprinus specularis* and *S. gemmenus*, the thoracic disk in front of the scutellum is larger and occupies the median area nearly to the neck, the four others are more obscure, especially the intermediate ones; the elytral punctures are strigose at and near the apices, the first and second striæ are short, basal, and just visible amongst the punctures; the sutural stria is clear and complete, commencing near the scutellum at the elytral disk and continuing round the apex; the sutural interstices are nearly smooth; pygidium densely punctured and convex on the disk before the apex; the prosternum is on the same plane as the mesosternum for half its length, and is then deflexed at a considerable angle; the lateral striæ are complete, joining at both ends, the keel is constricted in the middle, where the striæ nearly meet; anteriorly there is an outer and shorter stria; the mesosternum is emarginate in front, with a marginal stria, and somewhat coarsely punctured; the metasternum is narrowly punctured behind only, with a conspicuous, somewhat triangular, but shallow depression, which occupies nearly the whole of its median area; the legs are rather long, the anterior tibiæ narrow and falciform and without denticulations, but the end of the tibia is produced beyond the insertion of the tarsi into a very conspicuous hook, and the tibia itself is deeply grooved for the reception of the tarsal joints.

Hab. Rockhampton, Queensland.

Teretriosoma viridicatum, sp. n.

Cylindricum, æneo-viridum, nitidum, punctatum; mesosterno immarginato; pygidio in medio arcuatim carinato.
L. $2\frac{1}{2}$ mill.

Cylindrical, brassy green, metallic; head a little convex

between the eyes, clypeus nearly straight in front, both thickly and coarsely punctate; thorax less coarsely and less densely punctured, lateral stria well marked, especially at the anterior angles, but extremely fine behind the neck; scutellar spot shallow; elytra punctured similarly to the thorax except in the region of the scutellum, where the points are finer; the propygidium and pygidium are evenly and closely punctured, punctures finer than those of the sterna; the inferior portion of the pygidium is a little concave and is separated from the upper and convex part by a transverse semicircular ridge; prosternum, lobe distinctly marginate anteriorly, rather coarsely punctate, posteriorly arched, not incised; mesosternum punctate like the prosternum, and immarginate anteriorly; metasternum with smaller and much less thickly-set punctures, lateral stria oblique, median stria fine but faint; anterior tibiæ with seven denticulations, intermediate with six, the three centre ones being close together and having a common base, posterior 4-spinose.

The species is less brilliant and more cylindrical than *T. festivum*, Lew.

Hab. Bahia.

Teretriosoma cingulum, sp. n.

Cylindricum, viridum, nitidum; antennis pedibusque piceis; metasterno stria laterali semicirculari.

L. 2 mill.

Cylindrical, bluish green, shining above, nearly black beneath; head little convex between the eyes, evenly and closely punctured; thorax, stria complete, moderately strong at the sides, feebly sinuate, and very fine behind the head, punctured like the head, but the punctures are less closely set on the disk in front of the scutellum; elytra without striæ, punctured evenly like the disk of the thorax; the propygidium and pygidium are closely punctured, the pygidium being moderately convex; prosternum coarsely punctate, rather deeply incised at the base; mesosternum somewhat acutely produced in front, with anterior stria complete; the lateral stria of the metasternum is semicircular, well marked, and passes outwards behind the coxæ, the median line is obsolete; anterior tibiæ 6–7-dentate, intermediate 4-dentate.

This species is more cylindrical than *T. virens*, Mars.; the scape of the antennæ is without hair, and the prosternum and mesosternum are narrower, with the anterior marginal stria of the mesosternum well defined, not obscurely so as in *T. virens*.

Hab. Bahia.

Teretriosoma nigrescens, sp. n.

Subcylindricum, nigrum, nitidum, undique leviter punctatum; prosterno inciso; mesosterno marginato; antennis pedibusque piceorufis.

L. 2 mill.

Cylindrical, black, shining; head slightly convex between the eyes, covered with small punctures not thickly set, clypeus broad, slightly convex, and rounded off anteriorly; thorax slightly sinuous laterally, stria complete, punctures sparsely set, rather fine on the sides and on the disk, but large in front of the scutellum, without a scutellar impression; elytra evenly punctured throughout, with a posthumeral spot smooth, one short oblique stria at base; propygidium transverse, and with the pygidium evenly punctulate, the pygidium convex; prosternum coarsely but not thickly punctate, distinctly incised at the base; mesosternum correspondingly acute anteriorly and similarly punctate, with a well-marked marginal stria; the oblique lateral stria of the metasternum, as seen in *T. virens* and others, is absent, and the median line also; legs pitchy red; anterior tibiæ 7–8-dentate, intermediate 5-spinose, posterior 3-spinose; antennæ without pubescence.

This species is rather larger than *T. Grouvellei*, and the punctuation of the upper surface is much finer than in any other species at present described.

Hab. Guanajuato, Mexico.

Teretriosoma Grouvellei, sp. n.

Cylindricum, nigrum, nitidum, undique punctatum; mesosterno obscure marginato; pygidio convexo.

L. vix 2 mill.

Cylindrical, black, shining, wholly punctate; antennæ without pubescence, scape angulate in the middle of the upper edge; forehead slightly convex, clypeus flat; thorax, stria entire and well marked at the sides, but very fine behind the head, rather closely punctured, without a scutellar fovea; elytra also evenly and somewhat closely punctured throughout, not differing in the region of the scutellum; propygidium and pygidium more densely punctate, latter convex; prosternum coarsely punctate, the anterior lobe distinctly marginate, feebly impressed between the coxæ, and arched at base; mesosternum obtuse, anteriorly with marginal stria complete but obscure, coarsely punctate, so also is the metasternum; metasternal median line obsolete; tibiæ, intermediate 5-dentate, one small tooth near the base, two conspicuous in

the middle, two at the apex small and close together, posterior 4-spinose ; antennæ and legs pitchy black.

I have dedicated this species to my friend Mons. Antoine Grouvelle, whose work in the Cucujidæ and other families is well known, and to whom I am much indebted for many novelties in this family.

Hab. Bahia.

Teretriosoma plumicornis, sp. n.

Cylindricum, viridum, nitidum, punctatum; mesosterno stria subintegra; capite subtus, antennis pedibusque rufis.

L. $2\frac{1}{4}$ mill.

Cylindrical, bluish green, shining; head rather closely punctured and transversely convex, mandibles, head beneath, and abdominal segments reddish ; thorax similarly punctured in front and on disk, punctures larger at the base, no scutellar fovea, lateral stria strong, fine but clear behind the head; elytra without striæ, punctures rather more densely set apically, transversely impressed near the base ; propygidium densely punctulate ; pygidium gibbose above, feebly concave in the inferior half and throughout punctulate like the propygidium ; prosternum feebly arched at the base, closely punctate ; mesosternum feebly and obtusely produced, stria not quite complete anteriorly, punctate like the prosternum; lateral stria of the metasternum well marked and oblique, no median line; antennæ and legs red, scape pilose; anterior and intermediate tibiæ 7-dentate.

This insect is smaller and relatively narrower than *T. virens*, and the head and abdominal segments are red beneath. The lateral stria of the metasternum is also less oblique and stronger. The median line of the metasternum in *T. virens* is clearly visible but extremely fine.

Hab. British Honduras.

Teretriosoma pilicornis, sp. n.

Subcylindricum, viridum, nitidum ; antennis pedibusque rufis ; propygidio pygidioque dense punctatis ; mesosterno immarginato.

L. $2\frac{1}{2}$ mill.

Subcylindrical, bluish green, shining, antennæ and legs dull red, the scape bearing whitish hair on the upper edge ; head convex between the eyes, not closely punctured ; thorax, marginal stria complete, punctures rather closely set on the anterior angles, a little sparse on the disk, larger at the base, no scutellar fovea ; elytra punctured evenly throughout the

dorsal region, finer and closer at the apex, bases with a transverse impression, no striæ; propygidium and pygidium densely punctured, punctures finer than those on the elytra; pygidium transversely gibbous above and slightly impressed inferiorly; prosternum closely punctate, feebly arched at the base; mesosternum more sparsely punctate, punctures rather large; metasternum with a distinct median line, lateral stria oblique; anterior tibiæ 7-dentate, intermediate 7–8-dentate, the centre tooth in the latter is somewhat isolated.

This species is known from *T. virens* by the absence of a marginal stria on the mesosternum. The genus *Teretriosoma* now contains twenty-two species.

Hab. Central America.

Trypanæus rostratus, sp. n.

Cylindricus, niger, nitidus; *T. spinigero* proxime affinis at robustior; elytris lævibus.

L. $5\frac{1}{2}$–6 mill.

Cylindrical, black, shining, tarsi pitchy red.

♂. Head with two conspicuous tubercles over the eyes, the base of each is carried forward as a carina towards the apex of the rostrum; before the apex is reached the carinæ join and the extremity of the rostrum is elevated; in small examples the rostrum is not thickened at the end; in the middle of the rostrum there is a straight, well-defined carina, with a longitudinal sulcus on each side of it; between the two ocular tubercles the head is lightly scooped out in a semicircular outline; thorax sparsely punctured, anterior angles a little prominent; behind the neck are two obtuse tubercles rather close together, the marginal stria ceases in front of the tubercles; elytra nearly smooth, the punctuation being very fine and sparse; pygidium and propygidium distinctly and rather closely punctate, the former bearing flavous hair at the apex; the prosternum is incised at the base and margined with a fine stria on each side, the striæ are rounded off and meet anteriorly; the mesosternum is feebly and sparsely punctured, with a stria at the sides, which is evanescent in front; the metasternum has a well-marked median line and is punctured similarly to, but more distinctly than, the thorax. L. cum rostro $6\frac{1}{2}$ mill.

The female has the rostrum feebly punctured, head a little impressed between the eyes, without tubercles or carinæ; thorax, stria interrupted at the points corresponding to the tubercles in the male; the thoracic punctures are much larger, especially before the scutellum; the elytra are somewhat similar to those in

the male; the pygidium is obtusely produced, and the punctures on it and on the propygidium are finer than those in the male; the prosternum and mesosternum agree in both sexes, but the metasternum is much more coarsely and thickly punctured in the female; the fore tibiæ in both sexes have five or six strong teeth on the outer edge and a large tooth on the inner side near the base, which is very conspicuous in the male, but shorter and more obtuse in the female; in repose the large tooth rests in a femoral cavity. L. $5\frac{1}{2}$ mill.

Hab. Peru.

Trypanæus plagiatus, sp. n.

Cylindricus, niger, nitidus; pronoto tuberculato; elytris rufo-maculatis; metasterno antice in medio sulcato.

L. $2\frac{3}{4}$ mill.

Cylindrical, black, shining, lateral margin of the thorax at base, outer margin of the elytra, and a broad band (diffused rather than well defined) behind the scutellum, but not reaching the sides of the wing-case, red; male without ocular tubercles; the rostrum is parallel at the sides and terminates in an obtuse point, the outer margin has a fine carina, and a median ridge is just visible, the interstices are shining and smooth; thorax long, parallel and sparsely punctate at the sides, punctulate on the disk, and nearly smooth before the scutellum; behind the neck, about a fourth part down the thorax, is a small tubercle; the elytra are finely and sparsely punctulate, with a red band, widest at the suture; propygidium and pygidium rather densely punctate; prosternum bistriate laterally, striæ joining in front, almost truncate at both ends; mesosternum arcuate at sides, laterally striate, obtuse anteriorly; metasternum with a remarkably deep sulcus in front, which occupies about one third of its entire length.

♀. Forehead and rostrum somewhat uneven, rostrum faintly impressed longitudinally, punctures much scattered in the middle, clustered over the eyes; thorax evenly but not closely punctured; elytra smooth at the base, punctulate apically and partly up the suture; propygidium and pygidium evenly punctured, pygidium elongate, obtusely produced, convex above, and beneath the apex is hollowed out; the three sternal plates agree with those of the male.

The hinder tibiæ in both sexes are triangularly dilated.

Hab. Rio Janeiro.

Trypanæus fasciatus, sp. n.

Cylindricus, niger, nitidus; pronoto bituberculato; elytris rufo-fasciatis.

L. 3–$3\frac{1}{4}$ mill.

Cylindrical, black, shining, with a red band across the elytra before the base.

♂. Head and rostrum opaque, latter robust, parallel and carinate at the sides, obtusely pointed in front, ocular tubercle well marked; thorax evenly punctured anteriorly and at the sides, more sparsely and more finely punctured before the scutellum, behind the neck are two small tubercles set together, anterior angles reddish; elytra sparsely punctulate, punctures closest at apex and near the suture, before the base there is a rather broad red band; pygidium rugosely and densely punctured; prosternum carinated at the sides; mesosternum arched in front, bistriate; metasternum sulcate in the middle anteriorly; posterior tibiæ triangular and dilated. L. 3 mill.

♀. Head opaque, feebly punctured, ocular tubercle very small; thorax evenly punctate throughout; pygidium rather closely punctured, moderately produced and obtuse at the apex. L. 3½ mill.

This species resembles *T. plagiatus*, but it is more robust, with the rostrum broader and extending laterally in the males outside the carinæ; the two thoracic and the ocular tubercules also distinguish it from the preceding species, and in the female the pygidium is much shorter.

Hab. Bahia.

Trypeticus Grouvellei, Mars. Bull. Soc. Ent. Fr. (6) iii. p. 68
(*tabacigliscens,* Mars., ♂, *l. c.*).

The above names represent the sexes of one species, and I propose to retain the first for it, as Marseul gave the female the precedence in his paper, and also because I think it likely that Marseul's leading idea at the time of writing his descriptions was to dedicate a species to his friend from whom the specimens came. I think it well to adopt the name of *Trypeticus* suggested by Marseul for the eastern forms of *Trypanæus* which have a prosternum truncate at both ends; and I have done so in this paper.

Trypeticus obeliscus, sp. n.

Elongatus, cylindricus, angustatus, piceus, nitidus; capite inter oculos striato; pronoto distincte punctato, angulis elytrisque marginalibus testaceis; prosterno bistriato.

L. $2\frac{1}{8}$ mill.

♂. Cylindrical, narrow, piceous, angles of the thorax rounded off anteriorly, and these, with the margins of the elytra, are testaceous; head transversely convex before the neck, with a straight stria between the eyes which divides the forehead from the rostrum; the eyes are prominent, almost wholly seen from above, and nearly circular in outline; the

rostrum is oblong, truncate at the base, margins narrowly elevated, feebly punctulate on the surface, the anterior edge is very feebly reflexed and feebly emarginate; thorax striate at the sides, very distinctly and somewhat closely punctured, except in front of the scutellum, which has a very narrow irregular space smooth, behind the neck there is a short and fine line; the elytra are finely punctured with similar density, with a narrow margin at the bases and sutures smooth; the propygidium and pygidium are somewhat closely punctured, the latter is convex on its upper surface; prosternum feebly punctured, and it widens out a little anteriorly, truncate at the base, bistriate, striæ parallel; the mesosternum is wider, also feebly punctate, lateral stria straight and rather deep; metasternum less visibly punctate, median line well marked; legs and antennæ flavous, anterior and intermediate tibiæ 5-dentate, posterior tibiæ short and a little dilated.

Hab. Sumatra.

Trypeticus minutulus, sp. n.

Filiformis, brunneus, nitidus: affinis præcedenti at minor et angustior; pronoto tenuiter punctulato; elytris sublævibus.

L. vix 2 mill.

♂. Filiform, brown, shining, under surface, angles of the thorax, and edges of the elytra testaceous; head very similar to the last species, but much narrower, with eyes less prominent; rostrum also similar; thorax very finely punctate, anterior angles lightly produced, stria at sides only; elytra with punctures almost obsolete, also the propygidium; pygidium convex on the upper surface, visibly punctulate; prosternum oblong, striate at the sides, truncate at both ends; mesosternum half as broad again, equal to it in length, with similar striæ, both feebly punctate; mesosternum smooth, median line fine; anterior and intermediate tibiæ 5-dentate, posterior not dilated in the same degree as in *T. obeliscus*.

This species differs from *T. obeliscus* in being smaller, filiform, with thorax very finely punctured and not rounded off anteriorly, pygidium more finely punctured, and by the form of the posterior tibiæ. Both species are, however, allied, with the eyes prominent and the head narrowed behind the eyes. The frontal striæ, transverse and straight between the eyes, is also a remarkable character in each.

Hab. Sumatra.

Onthophilus punctisternum, sp. n.

Orbicularis, convexus, opacus, setosus; meso- metasternoque profunde et grosse punctato; elytris 10-costatis.

L. $2\frac{1}{2}$ mill.

Orbicular, opaque, setose; head with a carina on each side

commencing behind the eye and joining one another anteriorly, enclosing a triangular space, which is smooth in front and rugose behind; before the neck are three costæ, the median one much the longest; thorax, lateral margin elevated, with a conspicuous carina on each side which corresponds to the second elytral costa; behind the neck are four shortened costæ placed at equal distances; elytra have 5 setose costæ, the two sutural being close together and less raised than the others, the interstices have two rows of very large punctures, interspaces smooth; propygidium and pygidium very rugose; prosternum, the sides are carinate, the carinæ are not sinuous, but approach a little anteriorly, at the base there is a round shallow impression; the mesosternum is bisinuate in front, with a roughly fashioned fovea of irregular outline at each anterior angle, it is not distinct from the metasternum, and both are deeply pitted with large round punctures, not thickly nor regularly set; the median line of the metasternum is fine and interrupted by the punctures.

This species resembles *O. costipennis*, Fåhr.; the deep and round punctures in the sterna are a distinguishing character.

Hab. Zanzibar (Bagamoyo, *Raffray*).

Onthophilus bipartitus, Lew.—On further examining a series of this species I find that it is distinct from *O. costipennis*, Fåhr.

Colonides parvulus, sp. n.

Ovalis, niger, subopacus, pedibus rufis; fronte excavata; pronoto lateribus elevatis, punctatis; elytris striis 1^a–4^m integris, suturali postice obsoleta; propygidio transversim prominulo; tibiis dilatatis. L. $1\frac{1}{2}$ mill.

Oval, black, somewhat opaque, legs reddish; head carinate over the eyes, longitudinally excavated in the middle, sides of excavation raised; thorax anteriorly as wide as long, base a third wider, somewhat closely punctured throughout, sides a little elevated, with a shallow sulcus within the lateral margin, commencing behind the anterior angle and widest near the middle, scutellar fovea feebly impressed; elytra punctate like the thorax, striæ 1–4 complete and strong, with the interstices depressed, giving the striæ a raised appearance, all are parallel to each other and a little bowed, the fourth at the base approaches the sutural, sutural straight and wider than the others anteriorly, apically evanescent; propygidium punctulate and apically built up and projecting over the pygidium; pygidium feebly convex, closely but not densely punctured; prosternum, the keel is narrow, flat, incised at base, anterior lobe minutely and rugosely punctate; mesosternum produced anteriorly, bisinuous, transverse stria fine, straight, feebly crenulate, and on each side it merges into a strong and very conspicuous

straight carina, which continues across the metasternum until it has passed the hind coxæ; at the mesosternal suture there is a line of somewhat coarse punctures, in the metasternum on each side close within the carina is a row of five or six small foveæ; the suture again between the metasternum and first segment of the abdomen is punctate, the segment itself being finely punctulate on the surface; all the tibiæ are dilated, anterior pair obscurely dentate on the outer edge, posterior and intermediate obtusely angulate before the bases.

Hab. Mexico.

L.—*Description of a new Scincoid Lizard from North-western Australia.* By G. A. Boulenger.

Lygosoma Walkeri.

Section *Rhodona.* Body much elongate; limbs very weak, didactyle; distance between end of snout and fore limb contained twice and a half to three times in the distance between axilla and groin. Snout obtusely conical. Eye very small. Lower eyelid with an undivided transparent disk. Nostril pierced in the anterior part of a large nasal, which forms a suture with its fellow behind the rostral; frontonasal twice as broad as long, forming a broad suture with the frontal; præfrontals small and widely separated; frontal broader than the supraocular region, in contact with the first and second supraoculars; three supraoculars, second largest; five supraciliaries; frontoparietals small, fused to a single shield, which is much shorter than the interparietal; parietals forming a suture behind the interparietal; three pairs of nuchals; fourth upper labial entering the orbit. Ear-opening distinct, but very small. Twenty smooth scales round the middle of the body, dorsals largest. A pair of enlarged præanals. Fore limb as long as the mouth; hind limb as long as the distance between the ear and the fore limb; second toe more than twice as long as first. Tail thick. Greyish above, each scale with a black dot, which is largest on the fourth scale from the mid-dorsal line; lips with black dots; lower parts whitish, tail with black dots.

	millim.
Total length	113
Head	9
Width of head	6
Body	51
Fore limb	5
Hind limb	9
Tail (reproduced)	53

Specimens from Roebuck Bay and Condillac Island, North-west Australia, were presented to the British Museum by Mr. J. J. Walker.

MISCELLANEOUS.

Ad Historiam Cucumariæ. By F. Jeffrey Bell.

I. *Cucumaria* v. *Pentacta.*

In his valuable work on the Echinodermata, now in course of publication as part of Bronn's 'Klassen u. Ordnungen,' Prof. Ludwig remarks as a footnote to *Cucumaria*, "Streng genommen musste diese Gattung den älteren Namen *Pentacta* führen;" and he goes on with an enviable courage, "Der jüngere Name *Cucumaria* ist aber so allgemein in Gebrauch, dass er sich wohl nicht mehr wird verdrängen lassen." It is well, however, to be right at law as well as in equity, and I may therefore point out that "strenggenommen" *Pentacta* should replace *Colochirus*, for the sole type given by Goldfuss (Zool. i. p. 177) is *Actinia doliolum*, which, as Dr. v. Marenzeller (Abh. zool.-bot. Ges. Wien, xxiv. (1874), p. 303) has shown, is a *Colochirus*.

Cucumaria, then, is not to be displaced. I may add that *Colochirus* has been in possession for nearly half a century; with some systematists that fact may have weight.

The statement of Prof. Verrill that "*P. pentactes*, Jaeg., of Europe is properly the type of the genus *Pentacta*" rests upon a misapprehension; Jaeger himself says "Goldfuss hujus nominis autor est."

This correction will take us further, for it disposes of Verrill's suggestion that *Pentacta* should be used for the stichopodous and *Cucumaria* for the sporadipodous species of "*Cucumaria*" of authors—a suggestion which, by the way, Dr. Lampert should have remembered when he used *Cucumaria* in Verrill's sense of *Pentacta*.

II. *On the Meaning of the Term "Le fleurilardé."*

Among the many difficulties which surround the clear discrimination of *Cucumaria pentactes* is the meaning of Dicquemare's "Le fleurilardé" *. Since his time it is only rarely that the term has been correctly given, his "le fleurilardé" being written "la fleurilarde" by Cuvier and Lamarck and "l'holothurie fleurillade" by de Blainville. The compilers of French dictionaries have either, as is also the case with Littré and the French Academy, omitted the word, or, as in the Dict. des dict. and the Dict. nation., have "fleuribarde," "Ver radiaire du genre des holothuries," while "fleurilarde" is a "Zoophyte perdrigon violet tuberculeux." Valmont-Bomare (to whose work I was referred by my former colleague Professor Mariette), in his 'Dictionnaire raisonné universel d'histoire naturelle,' ed. 1791, vol. iii. p. 477, writes "Fleuri-lardé," and he says, "Le nom qu'il (Dicquemare) a donné à cet animal en fait une sorte de description . . . les trois doubles rangs des pieds qui sont aux côtés et au-dessous, au milieu de sa largeur, sont blancs, et présentent, à la forme près, l'effet d'un lièvre lardé ou piqué,"—which is, after all, but a quotation from the original description. I should be glad to hear of any other references to the name; the very considerable search I have made myself has had no more result than this.

* Observ. sur la Physique, xii. (1778), p. 283.

"*Eupodosaurus longobardicus.*"

The specimen noticed and figured under the above name in the last number of the 'Annals' (p. 292) turns out to belong to *Lariosaurus Balsami*, and has been figured by Curioni (Mem. Ist. Lomb. ix. 1863, pl. vii. fig. 1). I am indebted to the inquiries made at the Milan Museum by my friend Dr. J. de Bedriaga for this identification. Although I had examined the foot on the plaster cast of the entire *Lariosaurus Balsami* in the British Museum, the appearance, especially of the distal phalanges, differed so greatly from the College of Surgeons specimen that the identification of the two never occurred to me. G. A. Boulenger.

Oct. 13, 1891.

On the Habits of Gobius minutus *. By Frédéric Guitel.

Gobius minutus is found in abundance in the pools of water left by the ebbing sea on the sandy beaches of Roscoff. The habits of this little fish at the time of reproduction are extremely curious; they have been observed with the greatest accuracy, owing to the extremely favourable conditions afforded by the great aquarium of the station at Roscoff for this kind of observation. The water flowing in abundance through the tanks, the animals live in them as in the natural state.

The sexes are distinguished by constant differences in the coloration of the dorsal and anal fins. In the female the two dorsals are transparent and only marked with some small black dots situated upon their rays; the anal is perfectly transparent. In the male, on the contrary, the two dorsals bear three or four almost horizontal white bands, separated by two or three black bands. Moreover the first dorsal, which, as in the female, has six rays, presents two spots of a fine blue, each limited towards the base by a black crescent which is outlined by a white crescent. One of these spots is situated between the fourth and fifth rays, the other between the fifth and sixth; sometimes the second is wanting. Finally the anal is largely bordered with black.

If a female ready to lay, a male in the reproductive state, and a shell of *Cardium* or of *Tapes* are placed in an aquarium with its bottom covered with sand, the male is not long in introducing himself beneath the shell, only letting his head protrude beneath its rim. From time to time he enters his little mansion, drives out a large part of the sand which it contains by a rapid agitation of his tail, and even brings in his mouth small stones, shell débris, or small quantities of sand which he shoots out over the threshold of his domicile. Then he sets to work to conceal his shell completely. For this purpose he leaves it, places himself above, and, steering in a straight line, moves over the sand with a rapid agitation of his pectorals and his tail, so as to project behind him a wave of sand which accumulates on the shell. The track of his passage in the sand is marked by a deep furrow.

After he has scooped out the first furrow he reenters his house,

* The observations which form the subject of this note were made in the aquarium of the Laboratory at Roscoff (Finistère).

throws out the sand that has fallen on the passage to his door, and then comes out again at the end of some minutes to scoop out a second furrow in another direction. When this manœuvre has been repeated eight or ten times the shell is completely buried under a little hill of sand with rounded top, trenched with furrows disposed starwise, and pierced by a hole giving access to its concavity.

This hole is, in general, perfectly round, and just large enough to allow the master of the house to pass. Such a hole could not preserve its shape in sand if the grains forming its walls were not agglutinated by the mucus secreted by the skin of the animal when lying in its hole.

When his house is constructed—a house which, as we shall see, is a true nest—the male endeavours to entice the female to his home. For this purpose he comes out of his sanctuary, swims rapidly towards her, draws near her by little jerky bounds, pushes her frequently with his snout, and then returns rapidly towards his nest as if to show her the way to it. If the female, as usually happens, refuses to follow he returns to the charge, touches her again with his snout, and again makes a pretence of returning to his den; often he repeats this manœuvre five or six times together; then, discouraged by the indifference of the female, he reenters his dwelling, but not for long; for, at the end of a minute or two, often less, he comes out of it again and recommences his solicitations. One evening I observed a male who, in the space of three hours, came out of his hole seventy-eight times, and invited the female a hundred and sixty-eight times to share his nest.

When the male approaches the female to solicit her to follow him his colours suddenly become brighter, he erects his dorsals, raises his head vigorously, and spreads his opercles; at times also his body is agitated by a very visible trembling. When he has returned to his nest, his head, which he lets project out of the hole, becomes quite white, and he respires with a febrile activity which is in complete contrast with the normal respiratory rhythm. If the female approaches the agitation of the male becomes extreme; he retires quickly into his hole several times in succession, as if to call her in; but often the female retreats without deigning to respond to these advances; then he resumes his station, and soon recommences the solicitations described above.

At length, if the female decides to enter the shell with him, he remains at the entrance to the nest and waits for her to lay in a state of extreme agitation; but often she escapes immediately, in spite of the manifest efforts which he makes to prevent her from going out by extending his pectorals transversely. When the female consents to remain the laying commences. To do this she proceeds to the ceiling of the nest by the aid of the cupping-disk which she bears on her ventral surface and deposits her eggs by the way, which cling to the internal face of the shell by means of glutinous filaments regularly disposed at one of their poles. These filaments, secreted by the cells of the follicle, harden after remaining for some hours in sea-water.

After a certain number of eggs have been laid the female resumes

her natural position on the floor of the nest, and the male, proceeding in his turn to the ceiling, fecundates the eggs which she has fixed there. This manœuvre is repeated during an hour or two until all the ripe eggs have been expelled *.

When the process of laying is completed the female abandons the nuptial domicile, never to return; but the male remains and watches over the eggs until the young are hatched; for the small Crustacea which abound on the sandy shores, and on which *Gobius minutus* subsists (*Crangon, Mysis*), would eat the eggs were they not vigilantly guarded by him.

During the time that the development of the young is proceeding the male vibrates his tail and pectorals, so as to set up currents under the shell, which ensure the renewal of the water in it.

If after a male has made choice of a domicile under a shell we turn the concavity upwards, he restores it to its original position in the following manner:—

He begins by passing under the edge of the shell, rakes up the sand about it if necessary, then placing himself at the side opposite to the hinge, he nips one of the sides gently, and by a rapid movement of his tail describes a semicircle in the surrounding water in such manner as to swing round the shell till its concavity is underneath. Then he clears this at some point in its contour, and introduces himself beneath: he then throws out the superfluous sand in the interior and covers it as has been described above. When the male is guarding the clutch that he has fecundated the experiment is still more certain of success.

If we drive away a male from the nest he has prepared he is not long in returning to it, even if other shells resembling his own are placed near his dwelling for the purpose of deceiving him. If when a male is watching over the eggs which he has fecundated we drive him away and replace his shell by another, leaving the first at a little distance, when he returns he enters the shell which occupies the position the first had without hesitation; but he is not long in perceiving that it does not contain his eggs; then he quits it to seek for and retake possession of the first. He does not scruple to fight furiously if during the experiment another male has possessed himself of the shell containing his offspring.—*Comptes Rendus*, Aug. 10, 1891, p. 293.

On the Excretory Apparatus of the Carididæ, *and on the Renal Secretion of the Crustacea* †. By M. P. Marchal.

I. In a previous note I briefly described the excretory apparatus of *Palæmon*. I have since examined a few other Carididæ, which exhibit, in this respect, certain important differences. In *Nika edulis* the labyrinth is wanting; the gland is formed solely by the

* To make the observations respecting the laying, instead of supplying shells to the males I gave them watch-glasses, which I covered or uncovered at will by means of a brush.

† The investigations were carried out at the Arago laboratory (Banyuls-sur-Mer).

saccule, which opens directly into the vesical system *. The vesical system is constructed approximately upon the same plan as in *Crangon* †; there is no unpaired sub-stomachal bladder, but two sub-stomachal lobes, much closer together than in *Crangon*; this approximation appears to mark a transition towards the unpaired sub-stomachal bladder of *Palæmon*. There is a wide communication between the two vesical systems by means of a broad commissure, situated in front of the stomach, and prolonged beneath this organ by means of a median and unpaired mass which plunges into the labrum; we find a rich vesical collar surrounding the œsophagus.

Alpheus (*A. ruber*) exhibits a vesical system resembling that of the Crangonids. We meet with two sac-shaped lobes, descending along the sides of the stomach; on each side of the œsophagus there is detached a long narrow lobe, which extends as far as the base of the first pair of limbs.

In *Caridina Desmarestii*, a fresh-water type, the gland presents a saccule and a labyrinth. As in *Palæmon*, the saccule forms a little rounded mass, distinct from the labyrinth, partitioned in its interior, and projecting into the interior of the bladder; it communicates with the lacunæ of the labyrinth by means of a kind of atrium. The gland is capped on its inner face by a sac which represents the bladder; the latter is of small size, and presents the peculiarity of being continuous with a broad canal of which it is only the expansion; this canal winds somewhat, and opens, narrowing at the same time, at the level of the excretory tubercle.

II. The production of the urinary liquid in Crustacea is not due to a simple filtration, as the limpidity and abundance of the liquid which fills the bladder might lead us to believe; there is a real secretion, with separation of the cellular portions. In the liquid excreted by *Maia*, we find perfectly round and refringent globules of variable size; the same is the case for the Crayfish, the Spiny Lobster, &c.

In the *Paguri*, the clear liquid which inflates the abdominal bladder contains vesicles, which are more or less granular, often of large size, and may enclose a larger or smaller number of secondary vesicles. When the animal has been injected with indigo-carmine, we find blue granulations in these vesicles.

If we examine the bladder in the urine or the blood of the animal, we find that the cells are swollen so as to form domes, or large transparent vesicles, often enclosing secondary vesicles. On being set at liberty, they constitute the vesicles which we find in the excreted liquid; when they are free, their membrane has a very low degree of resistance: one drop of picro-carmine is enough to cause them to disappear in a few moments.

I have found the same swollen vesiculated cells in the bladder of the most varied types; it is evident that the bladder takes an important part in the secretion.

* Weldon has just determined the same fact in *Crangon*, and my independent researches on the same animal have confirmed this result.

† I described the bladder of *Crangon* in a previous note ('Comptes Rendus,' October 20, 1890).

The white substance of the Crayfish secretes in a manner analogous to that of the bladder; its cells are similarly swollen at their extremity into large clear vesicles, distinct from the body of the cell. As regards the cortical substance of the Crayfish, and the labyrinth of the other Crustacea, several vesicles exist at once in the same cell: they are, in general, tolerably numerous, oblong, and ranged regularly side by side: they then present the appearance of a sort of palisade, covering the cells, and the elements of which correspond pretty exactly to the striation of the bodies of the cells. The saccule equally secretes, by separating cellular portions, which are expelled in the shape of vesicles frequently coloured yellow.—*Comptes Rendus*, tome cxiii. no. 4 (July 27, 1891), pp. 223–225.

On the Circulatory and Respiratory Apparatus of certain Arthropods. By M. A. Schneider.

Amphipods.—I have injected *Talitrus*, the ordinary fresh-water Shrimp, and *Niphargus*. In all I found that the heart emits three pairs of lateral arteries, of which the first two arise immediately below the second and third pairs of cardiac ostia, while the third is given off pretty nearly in the middle of the space which separates the third pair of cardiac ostia from the origin of the posterior aorta. These lateral arteries give rise to numerous ramifications, which principally pass to the biliary apparatus.

Claus described lateral arteries in the *Hyperina*: to-day we are able to affirm that they exist in the whole group.

Arachnida. *Scorpion.*—The vessels formerly described by Newport and Blanchard in the Scorpion have more recently been regarded as simple lacunæ. Their primitive value must, however, be retained for them.

Sections of these vessels, in particular of the spinal artery, show a distinct wall, with striated muscular fibres, which are absent, on the contrary, in the neurilemma; successful injections never show extravasations, and those which contain nitrate of silver everywhere disclose a splendid endothelium. The same results are obtained in the Araneida.

The vascular topography, as determined by my predecessors, is correct in its ensemble; but many new details have presented themselves to me, into a detailed description of which I shall not enter, but confine myself to mentioning:—(1) Five transverse anastomoses between the two halves of the annular vessel, each giving off a *sternal* artery, which plunges into the sub-œsophageal mass; (2) four other sternal arteries, which arise below the initial portion of the spinal artery, and of which the posterior becomes the artery of the pectines; (3) anastomoses in the caudal region, or post-abdomen, not such as Newport described, but between the two branches formed by the bifurcation of the sternal arteries of this region and the posterior aorta.

Araneida.—I have studied the lung of Spiders and am absolutely convinced that the chitinous envelope, recently described as

surrounding this organ, does not exist, and that its description is partly due to the detachment of the cuticular substance underneath the lung, the separation of which has led to the belief in the existence of a floor or partition between the ventral surface of the body and the corresponding face of the organ in question.

The blood comes into direct contact with the leaves, entering between them by their dorsal edges, and then falls into the subpulmonary chamber, whence it can only escape by the vessel which conducts it to the pericardium, and thence to the heart.—*Comptes Rendus*, tome cxiii. no. 2 (July 13, 1891), pp. 94, 95.

On the Arterial System of Isopods. By M. A. Schneider.

Among the characters which the study of the arterial system had permitted us to assign to Isopods, was the existence of a vascular collar, anterior to the nerve-ring, giving off the subneural vessel, and furnishing in conjunction with the latter the arteries of the buccal appendages.

Nevertheless, in the Annelids, as well as in the Myriapods and Arachnids, the great aortic arch is, as in the case of the Vertebrates, situated behind the brain. Are we really confronted with an anomaly? My injections of *Porcellio* and *Ligia* enable me to reply in the negative.

Independently of the two arteries which continue the aorta in front, below the antennary arteries, running along the edge of the nervous collar, there exist, *behind this collar*, two arteries which arise from the aorta in the immediate neighbourhood of the point from which the ophthalmic artery starts. A peculiarity which distinguishes them is the loop formed by each around the base of insertion of a little ligament upon the stomach. They pass round the digestive tube, give off an anastomosing branch to the mandibular artery, and unite below the stomach and above the inferior nervous mass, thus describing a ring comparable in every respect to that of the Arachnids, and which is, manifestly, the great aortic arch of the Isopods, *dorsal* in position with reference to the nervous system. From this arch there pass, to the right and left, the arteries of the buccal appendages, with the exception of those of the mandibles, which start from a trunk common also to the antennary arteries.

Moreover, I convinced myself in the two types in question, that one or several anastomoses between the ophthalmic artery which arises behind the brain and the antennary arteries which are in front of it, unite these two trunks into a median arch or into two arches approaching the median plane, in such a way that this arch, with the aorta which subtends it, describes a *vertical* vascular ring which recalls that of the Amphipods.

Thus there fall to the ground two characters, one of which created a unique position for the Isopods from the point of view of general morphology, while the other tended to separate them profoundly from the Amphipods.—*Comptes Rendus*, tome cxiii. no. 7 (August 17, 1891), p. 316.

THE ANNALS

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LI.—*On the Development of Holothurians.* By Dr. HUBERT LUDWIG *.

MY sincere thanks are due to the Royal Academy of Sciences for having several years ago furnished me with the means of making a second † sojourn at the Zoological Station at Naples. For a long time I was prevented from going; and it was not until last spring that I was able to make the journey, the results of which I now have the honour to communicate.

I had proposed to myself, as the principal object of my investigations, to trace the development of a Holothurian as far as possible into the post-embryonic and post-larval life, and selected for the purpose the common Mediterranean *Cucumaria Planci*, since, from previous experiments, it appeared to be the most suitable of Mediterranean sea-slugs for prolonged culture in aquaria, and is universally regarded as a thoroughly typical Holothurian. At the same time I made further progress with my monograph on the Mediterranean Echinoderms, which I had undertaken for the 'Fauna

* Translated from the 'Mathematische und naturwissenschaftliche Mittheilungen aus den Sitzungsberichten der Königlich Preussischen Akademie der Wissenschaften zu Berlin,' Heft ii. Feb. 1891, pp. [179] 85–98 [192].

† The chief result of a former stay was the development of *Asterina gibbosa* (Zeitschr. f. wiss. Zool. Bd. 37, 1882).

und Flora des Golfes von Neapel,' and availed myself besides of the favourable opportunity for contributing to the solution of the question which has recently been raised as to the function of the madreporite of Echinoderms in general. The result of the observations which I directed towards this latter point I published some time ago in a paper entitled "Ueber die Function der Madreporenplatte und des Steinkanals der Echinodermen," which appeared in the 'Zoologischer Anzeiger,' no. 339, 1890. Another result of this last visit to Naples is the description which has just appeared * of the rediscovered Risso's *Molpadia musculus*, and to which I appended observations on the phylogeny and classification of the class Holothurioidea.

But to return to the principal object of my investigations as stated above, I may begin by remarking that I succeeded in keeping the young of *Cucumaria Planci* for a much longer time than any one had been able to do before in the case of this or any other Holothurian, as they were kept by myself from March 16 until April 17, and subsequently under the care of the excellent Conservator, Signor Lo Bianco, until July 9, therefore for a period of one hundred and sixteen days in all. On the whole, after the barrel-shaped stage is passed on the eighth and ninth day, the development thenceforward proceeds but very slowly. The larvæ and young animals are so absolutely opaque and so abundantly filled with calcareous bodies that I was forced to adopt the circumstantial method of careful decalcification and conversion into continuous series of sections, whereby I naturally had recourse to suitable methods of killing and preserving the animals. Owing to the minute size of the cells and the closeness with which the rudiments of the various organs are crowded together, none of the sections had to be thicker than 5–7·5 μ, in order to give trustworthy results. In consequence of these circumstances and the large number of figures required for a minute representation, the whole study makes considerable demands on time and patience. Publication in detail must therefore be postponed for some time. For the present I would confine myself to communicating as briefly as possible certain results which appear to me to be worthy of notice, while at the same time referring the reader to my critical treatise on the literature of the subject, which has just been published in Bronn's 'Classen und Ordnungen des Thierreiches.'

As at that time I had no reason for doubting the trust-

* "*Ankyroderma musculus* (Risso), eine Molpadiide des Mittelmeres, nebst Bemerkungen zur Phylogenie und Systematik der Holothurien," Zeitschr. f. wiss. Zool. Bd. 51, 1891, pp. 569–612.

worthiness of the statements made by Selenka as to the earliest developmental stages of *Cucumaria Planci*, I did not begin my investigations until the eighth day of the development. Subsequently, however, the conviction has forced itself upon me that my confidence went too far. The stages of the first seven days of development also must be investigated afresh, and I hope that I shall succeed in obtaining these this spring. The following observations, therefore, refer exclusively to stages which are older than seven days.

I was unable to confirm the customary view that in the Holothuria the plane of symmetry of the young Echinoderm coincides with that of the larva. On the contrary, these two planes intersect one another in the same way as I have proved them to do, *e. g.* in the development of *Asterina gibbosa*. In the anterior (oral) region of the stage which is transitional between the barrel-shaped larva and the young Echinoderm the plane of symmetry of the young animal diverges from that of the larva towards the left, but in the posterior region towards the right. The two planes of symmetry, therefore, cut one another at acute angles. In addition to this, the longitudinal axis also of the young *Cucumaria* is not identical with that of the barrel-shaped larva. In the anterior region of the body the longitudinal axis of the young *Cucumaria* diverges towards the ventral surface, in the posterior region, on the contrary, towards the dorsal surface from that of the larva. The peculiar difficulties which beset the proper orientation and the comprehension of transverse and longitudinal sections are evident at once from these conditions.

Water-vascular System.—The water-vascular ring and the radial canals have already assumed their permanent position on the eighth day. The spot at which the closure of the ring took place can no longer be distinguished. The general position of the water-vascular ring, corresponding to the relations of the plane of symmetry and the longitudinal axis as mentioned above, is such that its ventral region lies further towards the rear than its dorsal region, and at the same time its left half slightly further towards the rear than its right. It is only loosely connected with the fore-gut by means of few fine, short, suspensory fibrils. I was not able to detect muscle-fibres in the wall of the water-vascular ring at any of the stages which I examined. The five radial vessels arise from the ring with a wide lumen, without any constriction or formation of valves. The median ventral radial vessel on the eighth day already extends backwards with its blind end to a point somewhat beyond the place of origin of the first two sucker-feet canals, which arise from it and are already in existence.

On the following days it becomes more and more evident that this vessel exceeds the other four not only in length, but also in diameter. But, in addition to this, these four differ again among themselves, for the two latero-ventral canals are shorter and narrower than the two latero-dorsal ones. This difference between the five radial vessels continues far into the life of the young animal, and is only adjusted at a late period by means of subsequent processes of growth on the part of the four lateral radial vessels. Again, with regard to the formation of the musculature in the walls of the radial vessels, the median ventral canal is in advance of the remaining four, and among these, again, the two dorsal ones are in advance of the two ventral. For while the first distinct muscle-fibres appear in the wall of the median ventral radial vessel as early as the thirteenth day, it is not until the seventeenth day that the two latero-dorsal vessels acquire their first muscle-fibres, while three days more elapse before a similar event occurs for the two latero-ventral radial vessels. The whole of these muscle-fibres are limited to that section of the radial vessels which lies externally and posteriorly to the ring of pharyngeal ossicles. On the other hand, in the short portions of the radial vessels which lead to the water-vascular ring internally to the radial pharyngeal ossicles, I was still unable to detect any trace of muscle-fibres on the forty-fifth day of development. The muscle-fibres of the radial vessels are all longitudinal, are supplied from the cells of the epithelium of the hydrocœle, and occur (as in the case of the adult animal) in that wall only of the radial vessels which is turned towards the upper surface of the body, where they are arranged side by side to form a single layer.

The relations in which the young tentacles stand towards the regions of the body and the water-vascular system prove to be of especial interest. On the eighth day of development five tentacles have already been developed. Their position with regard to the mouth, and particularly with regard to the ciliated bands of the barrel-shaped larva, is different from that described by Selenka. They lie in a spacious oral atrium, into which they can be completely retracted; the atrium is then connected with the exterior by means of a circular sharp-edged opening. If, however, the tentacles are extended the oral atrium simultaneously flattens out, and the tentacles now enable it to be seen that they are all five situated in front of the second ciliated band of the larva (I regard the cilia of the cephalic hump as the first ciliated band). Selenka further states that the first five tentacles, when they are extended, are so arranged that, commencing from the front, we can

distinguish a first pair, a second pair, and an unpaired tentacle. The true state of the case is exactly the opposite: in front lies an unpaired tentacle, followed by the four others, in two pairs, one behind the other. This arrangement does not become perfectly distinct until we take into consideration the fact, which has been hitherto overlooked, that the plane of symmetry of the young *Cucumaria* diverges in front towards the left and behind towards the right from the plane of symmetry of the larva. The arrangement of the tentacles which I have just indicated refers strictly only to the plane of symmetry of the young Holothurian. With reference to the plane of symmetry of the larva, on the other hand, the tentacles are asymmetrically arranged, so that three of them belong to the left half of the body of the larva and the two others to the right.

According to Kowalevsky and Selenka the water-vessels of the first five tentacles arise immediately from the water-vascular ring and alternate with the radial vessels. This statement is absolutely erroneous. *The tentacular vessels arise, on the contrary, from the growing radial vessels.* Semon's speculations upon the phylogeny of Echinoderms, in so far as they are based upon the assumption that the primary tentacles in all Holothurians arise from the water-vascular ring, and on their part determine the true radii of the Holothurian body, consequently entirely miss the mark. In the case of *Cucumaria* their correctness is entirely overthrown by the fact that the first five tentacular vessels are by no means disposed in regular radial fashion. Were this the case a tentacular vessel would be given off from each of the five radial vessels. This, however, is not the fact. The arrangement of the first five tentacular vessels is neither radial nor bilaterally symmetrical, but *asymmetrical, in that the two tentacles of the two ventral interradii receive their water-vessels from the median ventral radial vessel, while the tentacle of the median dorsal, as well as that of the left dorsal interradius, is supplied from the left dorsal radial vessel, and lastly the tentacle of the right dorsal interradius from the right dorsal radial vessel.* The median ventral and the left dorsal radial vessels therefore each give off two tentacular vessels, but the right dorsal radial vessel only one. The points of origin of the two tentacular vessels of the median ventral radial canal are situated exactly opposite one another; so are also the two tentacular vessels of the left dorsal radial canal. The two latero-ventral radial vessels, on the other hand, give off for the present, so long as only five tentacles altogether are present, no tentacular canals at all, and therefore in this

respect are behind the three other radial vessels. Regarded from outside, it is the anterior unpaired tentacle of the eighth day of development and its neighbour on the left, which belong to the left dorsal radial canal; the tentacular vessel on the right of the unpaired one belongs to the right dorsal radial canal; the two tentacles of the posterior pair, however, are those which are furnished from the median ventral radial canal.

The relation of the primary tentacles to the radial vessels, which has just been described, is perfectly constant. It was possible to demonstrate it without meeting with a single exception for all the numerous young *Cucumariæ* of the most widely different ages, from the eighth to the hundred and fifteenth day, in uninterrupted series of transverse and longitudinal sections, and may therefore be regarded as a rule, though certainly a very peculiar one.

It was not until the hundred and sixteenth day that among a portion of the young animals an increase of tentacles took place, and seven altogether were found to be present. The sixth and seventh tentacles are situated exactly opposite one another with reference to the median plane of the Holothurian, and receive their water-canals from those two radial vessels, which hitherto had taken no part whatever in the giving off of tentacular vessels, namely from the right and left ventral radial vessels. The two radial vessels each send off the new tentacular vessel in a dorsal direction, therefore into the left and right dorsal interradii. Previous to this only a single tentacle existed in each interradial region surrounding the mouth. Now, however, after the formation of the sixth and seventh tentacles, each of the two latero-dorsal interradii possesses two, while the median dorsal and the two ventral interradii now as before each accommodate only one. The seven tentacles are accordingly disposed upon the five interradii in precisely the same way as that which I determined years ago in the seven-tentacled young of the viviparous *Chiridota rotifera*. Since in the adult ten-tentacled *Cucumaria* each radial vessel gives off two tentacular canals, we may conjecture, as regards the further multiplication of the tentacles, that the eighth arises on the left (dorsal) side of the right dorsal radial vessel, the ninth and tenth, however, on the ventral side of the left and right ventral radial vessels, whereby an exactly radial distribution of the ten tentacles of the adult animal is finally attained. In connexion with the successive development of the tentacles which has thus been traced, it may also be worth while mentioning the fact that the two ventral tentacles, although in the adult animal they

are considerably smaller than the remaining eight, belong not to the five secondary tentacles, but to the five primary ones.

The whole of the tentacular canals arise from the radial vessels by a basal portion, which is at first very short and narrow, but afterwards increases in length, and which opens by means of a valve into the wider section of the tentacular canal, lying in the tentacle itself. These valves, in spite of their small size, are constructed of two semilunar folds, precisely as is already known to be the case in the tentacles of *Synapta*. The narrow basal portions of the tentacular canals, as well as the valves at the distal end of these portions, lie internally to the radial ossicles of the pharyngeal ring, which are already present on the eighth day of development. Beyond the valve the expanded section of the tentacular vessel bulges out backwards, forming a short cæcal process which lies outside the young calcareous ring, and there rests upon the lateral branches of two neighbouring radial ossicles. This cæcum is the rudiment of the homologue of a tentacular ampulla, which Hérouard has shown to exist in the adult animal. No muscle-fibres could be distinguished in the wall of the narrow portion of the tentacular vessel, even in the most advanced of the developmental stages examined. In the expanded portion, on the other hand, distinct *longitudinal muscle-fibres* (and only such), furnished by the cells of the epithelium of the hydrocœle, appear in a single layer as early as the tenth day. Until the fifteenth day the tentacles are simple cylindrical structures with rounded tips, which are beset by the tiny hyaline papillæ already noticed by Krohn and Selenka. On the day named the subsequent *arborescent shape* of the tentacles begins to be ushered in, by the bifurcation of the tips. On the following days these two branches are soon succeeded by other branches which appear below the tip. The whole of the branches enclose from the beginning a cæcal process of the tentacular vessel.

Rudiments of the *first two feet* are already present on the eighth day. At first they each lie concealed in a pit-shaped hollow of the integument, and on emerging from this pit, which then flattens out, have the form of a small hemispherical protuberance. During the following days they elongate more and more into cylindrical tubes, and on the eighteenth day a well-developed terminal disk can already be distinguished. The two primary feet receive their water-vessels, as has already been observed by Selenka, from the terminal portion of the median ventral radial vessel, from which they arise exactly opposite one another. Nevertheless, by closely observing them from the eighth to the eighteenth

day, we notice that the right foot projects from the surface of the body a little in advance of the left, which again is traceable to the fact that the plane of symmetry of the Holothurian assumes the oblique position with regard to the plane of symmetry of the larva which has already been mentioned. The *musculature* of the young feet arises in immediate prolongation of the musculature of the radial vessel, exclusively in the shape of longitudinal muscle-fibres, on the outer surface of the pedal vessel, and originates, precisely like the muscles of the radial vessels and the tentacles, from the cells of the epithelium of the hydrocœle. As early as the tenth day (therefore even before the appearance of the muscle-fibres in the corresponding radial vessel) the longitudinal muscle-fibres form a fine unilamellar sheath, which is still absent in that section of the pedal canal only, which very much later bulges out to form the pedal ampulla. At the point of origin of the pedal vessel from the median ventral radial vessel a valvular arrangement is indeed present, but much more feebly developed than the similar valves of the tentacular canals.

A *third foot* does not make its appearance until the forty-fifth day. It arises in front of the two primary feet, always lies to the left of the median plane, and, like the others, receives its water-canal from the median ventral radial vessel, which consequently now supplies two left feet and a right one. In the meantime, from the proximal portion of the first two pedal canals, there have arisen ampulliform expansions into the body-cavity.

On the eighty-fourth day a *fourth foot* has come into existence, which likewise derives its water-canal from the median ventral radial vessel. It lies still further towards the front than the third, nevertheless not to the left but to the right.

A further increase in the number of feet does not take place until the hundred and eleventh day. The *fifth foot*, however, which then appears, no longer belongs, like its forerunners, to the median ventral radial vessel, nor even to the ventral surface at all, but arises on the left (=ventral) side of the left dorsal radial vessel, and, moreover, in the region of the anterior half of the body. The same two radial vessels, therefore, are now taking part in the formation of feet, which also in the formation of tentacles in so far preceded the rest of the radial vessels that they were the first to furnish their definite number of two tentacles each.

The *Polian vesicle* lies, contrary to the position attributed to it by Selenka in his figure, not in the right half of the body, but without exception in the left, and, indeed, invariably in the left dorsal interradius, and consequently in the abso-

lutely constant position in which Hérouard also met with it in the adult. No valvular arrangement whatever is present at its wide-mouthed opening into the water-vascular ring. From the fifteenth day onwards circular muscle-fibres may be recognized in its wall: they are arranged concentrically in a single layer round a point corresponding to the blind end of the vesicle. The muscular layer ceases at the opening of the vesicle into the water-vascular ring. In its origin it also is derived from the hydrocœle-cells, which represent the inner epithelium of the entire water-vascular system.

The young *stone-canal* possesses a vesicle-shaped expansion, overlooked by Selenka, the epithelial coat of which preserves the same constitution as in the rest of the stone-canal only in the inner half of the vesicle (*i. e.* the one which is turned towards the interior of the body), while in the outer half (*i. e.* that lying nearer the surface of the body) it is greatly flattened. This expansion is the earliest rudiment of the subsequent madreporic head of the perfect stone-canal, and may therefore be designated as the "*madreporic vesicle.*" Hitherto it has only been casually noticed by Bury, and termed by him the "anterior enterocœle." On the part of the mesenchyma it is surrounded by an incomplete calcareous *lattice-work envelope*, which has long been observed in other Holothurians. The valve which was supposed by Hérouard to exist in the adult *Cucumaria* at the exit of the stone-canal from the water-vascular ring is not present; the columnar epithelium of the stone-canal passes at this point almost suddenly into the pavement-epithelium of the water-vascular ring. The outer end of the primary stone-canal, leading from the madreporic vesicle to the dorsal pore, lies, as does the dorsal pore itself, which is subsequently obliterated, about the eighteenth to twenty-fourth day, not in the median plane of the Holothurian as determined by the dorsal mesentery, but to the right of it, which is once more explained by the oblique position of this median plane with reference to that of the larva, to which frequent allusion has already been made. In the same way it is perhaps possible to explain the preference which the stone-canal of adult Holothurians, especially in the Aspidochirotæ, exhibits for the right half of the body. In young animals of the ninety-eighth day the madreporic vesicle has opened into the body-cavity on its thin-walled side, thereby effecting the permanent connexion between the stone-canal and the body-cavity.

Nervous System.—On the eighth day of development rudiments of the central portions of the nervous system, the circumoral ring, and the radial nerves already exist. Both

the nerve-ring as well as the radial nerves emanating from it at this stage consist solely of closely-packed cells, arranged in several layers one above the other. It is not until the following day that beneath the cells of the nerve-ring a very finely fibrillar layer is visible, the fibres of which run parallel with the longitudinal axis of the nerve-ring. From the thirteenth day onwards we observe isolated cells scattered about at random between these fibres. With this the structure of the nerve-ring has reached a point at which it remains in all subsequent stages of development examined by me. It therefore consists of a superficial layer of cells (*i. e.* a layer turned towards the exterior), and beneath this a layer of fibres sheltering scattered cells. The five radial nerves resemble the five radial vessels of the water-vascular system which they accompany in so far as they differ from one another in thickness and length and also develop unequally fast from a histological point of view. As among the radial vessels, so also in the radial nerves the median ventral one is in advance of the others, and among the latter, again, the two dorsal take precedence over the two ventral ones. Even on the eighth day the rudiment of the median ventral nerve extends to beyond the rudiment of the first two feet, and here reaches somewhat further backwards than the blind end of the median ventral radial vessel. The histology of the median ventral radial nerve is similar to that of the nerve-ring, since on the eighth day the nerve consists solely of cells, but on the ninth of a layer of cells, which is merely superficial, and of a subjacent layer of fine longitudinal fibres. The separation of this fibrous layer commences in the proximal portion of the nerve, and from here gradually progresses until it reaches the distal portion, though the extreme end of the nerve always retains a purely cellular character in the stages which I examined. In one respect only is the nerve-ring temporarily in advance of the median ventral radial nerve, namely with regard to the appearance of cells in the interior of the fibrous layer. At the time when we meet with cells in the fibrous layer of the nerve-ring (*i. e.* the thirteenth day) they are as yet entirely wanting in that of the radial nerve. On the twelfth day the separation into outer cellular and inner fibrous layer can be seen in the two latero-dorsal nerves also, while the same separation in the case of the two latero-ventral nerves is not visible until the eighteenth day. Primarily the cellular stratum of the radial nerves is two to three layers thick; subsequently, however, it is only one layer thick, and it then represents the well-known external marginal cells of the adult.

On the ninth day the nerve-ring gives off five tentacular nerves, which are interradial in origin and lie upon the muscular layer of the tentacular vessels, on the side which is towards the mouth. On the seventeenth day a nerve-branch may be observed passing off from each side of the posterior region of the median ventral radial nerve to the primary foot.

As early as the eighth day of development the nervous system of the young animal has no longer any connexion whatever with the ectoderm of the surface of the body or of the oral atrium; it is everywhere separated from the ectoderm by an intervening layer of mesenchyma. Nevertheless the outer surface of the nerve-ring and of the radial nerves does not come into immediate contact with this mesenchyma, but is separated therefrom by a cleft which persists throughout the whole of the subsequent life as an "epineural ring" in the case of the nerve-ring and as an "epineural canal" in the case of the radial nerves. The epineural ring and epineural canals are in free communication with one another from the beginning; the latter are merely processes of the former. On the other hand, a connexion between the epineural cavities and any other cavity of the body could not be determined. It follows from these observations that Hérouard is perfectly right in regarding the epineural ring and epineural canals of the adult animal as normal structures. The tentacular and pedal nerves are also accompanied by epineural spaces; those of the tentacular nerves branch off from the epineural ring, those of the pedal nerves from the corresponding radial epineural canal.

Until the twentieth day the young radial nerves lie immediately upon the outer walls of the radial vessels. It is not until this day that—and at first, too, only in the median ventral radius—a very fine cleft gradually appears between the inner side of the radial nerve and the outer side of the radial vessel. In all probability this cleft is the rudiment of the subsequent radial "pseudo-hæmal canal." As soon as this cleft is formed, cells which are derived from the lateral margins of the radial nerve pass to the outer wall of the cleft, here to become the inner marginal cells of the perfect radial nerve.

On the other hand, I was unable to recognize, even in the latest of the stages examined, either the perpendicular fibres, or the transverse septum, or a trace of the two cellular columns formed by the outer marginal cells, and therefore think I am entitled to suppose that all these arrangements which are known to exist in the radial nerves of the adult animal are to be regarded as secondary acquisitions.

Auditory organs, which from general considerations I hoped to find, I sought for entirely in vain. In no shape, and at no stage of development, either upon the nerve-ring or the radial nerves, was I able to detect anything of the kind.

The musculature of the body-wall is furnished from the cells of the parietal enterocœle. First to be formed is the median ventral longitudinal muscle, which, on the ninth day, can already be distinguished as a fine single layer of longitudinal fibres on the inner side of the median ventral radial vessel. On the thirteenth day the rudiment of this muscle has already become somewhat broader than the transverse diameter of the radial vessel. The separate fibres of which the muscle consists lie closer together than the muscle-fibres in the outer wall of the radial vessel, from which they are subsequently still further distinguished by their more than double thickness. In front the young longitudinal muscle commences (as in the case of the adult animal) on the outer side of the corresponding radial ossicle of the pharyngeal ring; posteriorly it extends as far as the region of the origin of the first two pedal vessels.

Not until after the median ventral longitudinal muscle has been formed do we observe, on the fifteenth day, isolated transverse muscle-fibres on the outer surface of the parietal enterocœle, and on the eighteenth day a transverse muscular layer of the body-wall, interrupted in the radii, is distinctly visible. At the anus the transverse muscle-fibres draw closer together and form round it a sphincter-muscle (forty-fifth day).

The four longitudinal muscles of the lateral radii in the order of their appearance and in their original inequality of strength follow the relations of the radial vessels and the radial nerves, since in their case also the two latero-dorsal precede the two latero-ventral ones both in point of time and in actual length. The former are visible on the seventeenth day, the latter not until the forty-fifth.

The splitting-off of the retractile muscles from the longitudinal ones appears to take place very late, since I was only able to detect the first traces of it in a few individuals of the hundred and eleventh day.

The calcareous bodies of the integument are already visible in the stage of the barrel-shaped larva, and are taken over *en masse* by the young *Cucumaria*, so that a true larval skeleton, peculiar to the larva, does not exist. Each calcareous body originally has the form of a tiny rod, which, by repeated bifurcations of its ends, which always take place at an angle of 120°, and subsequently by the contact and fusion

of its branches, develops into a small lattice-work plate. In the course of this process it may be seen that a thickening of the rods simultaneously takes place by apposition. Hérouard's view, according to which only a single formative cell corresponds to each mesh of the latticed plate, is not supported by my observations; on the contrary, I observed as distinctly as possible that usually several, *i. e.* two to six, formative cells occur in each mesh. The five foremost latticed plates are so arranged that their longitudinal axes fall exactly in the direction of the radii. These five plates together form a pentagonal projecting sheath for the crown of tentacles. Each tentacle corresponds in position to the line of contact of two plates. Further backwards these five oral latticed plates (=pseud-oral plates) are connected with others of similar formation, which originally come into contact with each other just as little as do the oral plates at their first appearance. Soon, however, they become larger and more numerous, collect close together, and then thrust their edges over one another like the slates of a roof, so that the fore border of one plate rests upon the hind border of the one next in front. In the walls of the tentacles and feet, also, smaller latticed plates very soon appear in large numbers. About the hundredth day a second sort of calcareous body is seen to appear in the integument of the trunk, occupying a position nearer the surface than the latticed plates which have hitherto alone been present. It is distinguished by its remarkable smallness, elegance, and richly-branched shape, and in form it is arched in such a way that its concave side is turned outwards, its convex side inwards. Further particulars as to the form, origin, and arrangement of the calcareous bodies and their relation to the calcareous bodies of the adult will be communicated by means of figures in my detailed memoir. There, also, it will be proved that the calcareous ring is formed from the body-wall, and shows remarkable relations between its radial ossicles and the ambulacral ossicles of the skeleton of the starfish.

Integument and Mesenchyma.—The circumstance appears to me to be not without interest that after the complete disappearance of the ciliated bands of the larva it is not possible to make a sharp distinction either between the ectoderm and the gelatinous nucleus of the cephalic hump (so long as this is still present in the neck of the young *Cucumaria*), or between the ectoderm and the mesenchyma of the wall of the trunk. Ectoderm and mesenchyma in young Cucumarians form a single tissue, which does not differentiate until later

into a distinct epithelium and a subjacent layer of connective tissue.

Blood-vascular System.—The supposition that the blood-vascular system, as I was the first to demonstrate in the case of a starfish, would be traceable to remnants of the segmentation-cavity, or at any rate to clefts in the mesenchyma, has fully justified itself. Between the visceral layer of the enterocœle and the endodermic wall of the mid-gut there appears on the thirteenth day a distinct space, which partly bulges out to form the marginal vessels of the perfect intestine and partly develops into the blood-spaces which are found in the thickness of the wall of the mature intestine. On the seventeenth and eighteenth days we can already observe the development of a mesenterial and an antimesenterial marginal vessel upon the mid-gut, to which during the following days a simple transverse vessel is added.

Just as between the visceral layer of the enterocœle and the endoderm of the mid-gut, so also, in a similar way, lacunar vessels are developed between the parietal layer of the enterocœle and the mesenchyma of the body-wall. Since a firm and intimate fusion of the parietal enterocœle with the body-wall takes place in the region of the radii only, in the intermediate spaces, that is in the interradii, a gap remains between the enterocœle and the body-wall, which may be detected even in quite young stages, and is identical with the large lacuna of the body-wall described by Hérouard in the adult animal.

Digestive Organs.—The oral atrium already alluded to is clothed by a very flat unilamellar epithelium, which is directly continuous with the external covering of the tentacles. At the bottom of the oral atrium lies the opening of the mouth, which on the eighth and ninth day is extraordinarily narrow and takes in no food as yet. The folding of the intestine, subsequently so strongly marked, is already indicated on the ninth day, and from the beginning follows the same regular direction as in the adult animal. The fore-gut narrows posteriorly, and on the twelfth day is already attached by means of fine radial strands of connective tissue to the inner side of the young calcareous ring. Not less distinct and much more numerous are at the same period the suspensory cords which attach the hind-gut to the body-wall. On the fifteenth day the mid-gut has widened considerably; the fore-gut is now marked off from it by a sharp constriction. On the seventeenth day I was able to observe food (Diatoms) in the mid-gut, derived from without, although at this time the food-supply stored up in the gelatinous nucleus of the cephalic

hump is not yet exhausted. Mouth and fore-gut also have now become more spacious than before, and the mucous membrane of the latter exhibits distinct longitudinal folds. Moreover, the fore-gut by this time (eighteenth day) possesses a layer of distinct circular muscle-fibres, which appear to me to be in no way derived from cells of the mesenchyma, but from the enterocœle-cells which lie closely upon the fore-gut. From the mid-gut an anterior portion is constricted off, which becomes the stomach of the adult, but as yet possesses muscular fibres in its wall just as little as does the remainder of the mid-gut. In the later stages also which were examined by me I failed to trace muscle-fibres in stomach and mid-gut, while in the end-gut from the forty-fifth day onwards longitudinal muscle-fibres were distinctly recognizable.

LII.—*Natural History Notes from H.M. Indian Marine Survey Steamer 'Investigator,' Commander R. F. Hoskyn, R.N., commanding.*—Series II., No. 1. *On the Results of Deep-sea Dredging during the Season* 1890–91. By J. Wood-Mason, Superintendent of the Indian Museum, and Professor of Comparative Anatomy in the Medical College of Bengal, and A. Alcock, M.B., Surgeon I.M.S., Surgeon-Naturalist to the Survey.

[Continued from p. 362.]

[Plate XVII.]

Phylum **ECHINODERMA.**

Class **ASTEROIDEA.**

The Asteroidea form a good collection, which we have arranged under twenty-three species, sixteen genera, and eight families. Of these twenty-three forms nine appear to correspond with species described in the 'Challenger' Report, while fourteen seem to be new to science.

Except as regards life-coloration and distribution we have not been able to learn anything very new concerning the Asteroidea of the deep sea. Most of them appear to live, like their shallow-water relatives, upon Mollusca. In the stomachs of some of our specimens the carapaces of Crustacea have been found. The Porcellanasteridæ, so far as our rather limited

observation goes, seem to live, like many Holothurians, on the organic matter to be found in ocean mud.

Several ilustrations of the wideness of ocean-range of deep-sea species are furnished by our collection of Asteroidea.

We must here express our indebtedness to Mr. Percy Sladen's very valuable Report on the 'Challenger' Asteroidea, without which indeed we should hardly have ventured upon the examination of our collection.

Order PHANEROZONIA.

Family **Archasteridæ**.

PARARCHASTER, Sladen.

1. *Pararchaster semisquamatus*, Sladen.

Pararchaster semisquamatus, Sladen, 'Challenger' Asteroidea, p. 7, pl. ii. figs. 1 and 2, pl. iv. figs. 7 and 8.

One specimen from Station 111, 1664 fathoms.

Colour in the fresh state uniform salmon-red.

PONTASTER, Sladen.

2. *Pontaster hispidus*, sp. n.

Near *Pontaster mimicus*, Sladen.

Rays 5. R=nearly 7 *r*.

Rays elongate, tapering; abactinal surface plane; interbrachial arcs acute.

Abactinal surface of disk and rays covered with close-set paxillæ of two forms; the majority are small and are surmounted by a few small granules, but a large number on the disk and along the central axis of the ray are larger and are surmounted by numerous small granules surrounding a long central spine.

Marginal plates closely covered with capillary spinelets; the supero-marginals, about 44 in number, are almost confined to the lateral aspect of the ray, are tumid above the general abactinal plane, and are armed each with a long stout spine; the infero-marginals, which are larger than the supero-marginals, alternate with these, and are armed each with a long stout spine, and sometimes with a smaller finer spine below this.

Adambulacral plates with a prominent semicircular furrow, margin bearing about ten widely radiating spinelets, and with a strong actinal boss bearing a long stout spine. Mouth-

plates short, broad, tumid, each plate edged with about seven spinelets, which increase in length from periphery to centre, and armed actinally with about six unequal irregular spinelets.

Actinal interradial areas small, the plates covered with capillary spinelets; there are one or two inconspicuous multivalve pedicellariæ in each area. Similar pedicellariæ, but smaller, occur in the interbrachial arcs between the supero- and infero-marginal plates.

Anal aperture subcentral, surrounded by paxillæ with long central spinelets, which form a close palisade.

Papularia compact, well-defined, tumid, each with from 12 to 16 very close-set papulæ.

Madreporiform body small, round, convex, situated close to the margin of the disk, with a single large paxilla to its central side.

Colour in the fresh state uniform pale orange-pink.

Station 106, 1091 fathoms, and Station 108, 1043 fathoms; numerous specimens, of all stages of growth.

Dytaster, Sladen.

3. *Dytaster exilis*, Sladen.

Dytaster exilis, Sladen, 'Challenger' Asteroidea, p. 65, pl. ii. figs. 3 and 4.

Several specimens from Station 117, 1748 fathoms, and Station 118, 1803 fathoms. This species was also dredged in the year 1888 in the Bay of Bengal in 1924 fathoms.

Colour in the fresh state salmon-pink.

4. *Dytaster anacanthus*, sp. n.

Rays 5. $R = 6{\cdot}25\, r$.

Disk small, irregularly inflated; rays long and tapering; interbrachial arcs rather acute.

Abactinal surface densely crowded with paxillæ formed of narrow tabulæ surmounted by close-set granules; those in the centre of the disk and in a narrow band along the middle of each ray are smaller than elsewhere.

The supero-marginal plates, about 45 in number, are entirely vertical and lateral, and are uniformly covered with papilliform granules without any large spines or tubercles. The infero-marginal plates correspond in number and arrangement with the supero-marginals, which are exactly superposed; they are uniformly covered with papilliform granules

and bear medially, except in the peripheral third of the ray, each a long adpressed styliform spine.

Adambulacral plates rather long, each with a furrow-series of six obtuse spinelets, and with a mass of small spinelets, which form often three longitudinal series, actinally. Mouth-plates large, prominent, the suture between each pair widely open; the innermost mouth-spine of each plate much enlarged; actinally each plate is covered with numerous small spinelets in about three longitudinal series.

Actinal interradial areas small, the plates covered with small papilliform spinelets.

Madreporiform body situated near the margin of the disk and almost entirely concealed by paxillæ.

Anal aperture small, central.

Colour in the fresh state uniform light rose-madder.

Station 117, 1748 fathoms.

PERSEPHONASTER, gen. nov.

Allied to *Plutonaster*, Sladen.

Disk rather large, flat; rays rigid.

Marginal plates more or less covered with papilliform spinelets, and bearing each one or more strong rigid spines; the supero-marginals, which form a broad massive border on the abactinal surface of the ray, directly superposed on the infero-marginals, plate to plate.

Abactinal area with close-set paxillæ, which on the rays are arranged in transverse rows without any definite median series; papulæ distributed everywhere between the paxillæ.

Actinal interradial areas large, with intermediate plates extending far along the ray.

The adambulacral plates bear a furrow-series of obtuse, compressed, slightly radiating spinelets, and actinally two or more longitudinal series of papilliform spinelets.

Madreporiform body small, rather concealed, situated distant from the margin of the disk.

Anal aperture subcentral.

No pedicellariæ.

5. *Persephonaster croceus*, sp. n.

Plutonaster, sp., Wood-Mason and Alcock, Ann. & Mag. Nat. Hist. 1891, vii. p. 13.

Rays 5. R = 4·5 *r*.

Rays moderately long, rigid.

Abactinal surface of disk and rays with close-set spinose paxillæ, which become small and crowded towards the subcentral anal aperture; those of the rays are somewhat obscurely arranged in transverse series.

The whole abactinal surface is perforated with close-set papulæ. The supero-marginal plates are 31 in number and are directly superposed on the infero-marginals, plate to plate; each plate is coarsely granular in the middle and covered near the margin with capillary spinules, and bears two rigid spines, one at the abactinal, the other near the actinal end, the former being the smaller and often bifid. The infero-marginals correspond, plate to plate, with the supero-marginals; they are uniformly covered with papilliform granules, which are largest in the middle of the plate, and each bears near its abactinal end a stout rigid spine, beneath which is an obliquely vertical row of three or four slender movable spines.

Adambulacral plates with a slightly convex furrow-margin, armed with a comb of six or seven longish compressed spines; actinally there are two longitudinal series of small, inflated, longitudinally-grooved (barleycorn-shaped) spines, four in each series. Mouth-plates small, tumid, with close suture; each plate with a furrow-series of about seven spines, the most adcentral of which is of enormous relative size, and with two longitudinal series of close-set papilliform spinelets on the actinal surface.

Actinal interradial areas large, the intermediate plates extending halfway along the rays; each plate closely covered with "barleycorn" spines.

Madreporiform body small and inconspicuous, situated about two diameters from the margin of the disk.

Ambulacral groove extremely broad and open; tube-feet large, conical.

Colour in the fresh state olive-yellow, marginal plates pink, tube-feet red.

Station 109, 738 fathoms.

6. *Persephonaster rhodopeplus*, sp. n.

Rays 5. R = 3·5 *r*.

Rays rather short, rigid.

Abactinal surface of disk and rays covered with very close-set tabulate paxillæ surmounted by numerous flat-topped granules; the paxillæ are very small and crowded towards the subcentral anal aperture; those of the rays are arranged

in transverse curved rows. The whole abactinal surface perforated with close-set papulæ.

The supero-marginal plates number about 28, and are directly superposed on the infero-marginals, plate to plate; they are covered with granules, which are largest in the middle of the plate, and are armed with rigid spines—those in the interradia with one, those along the rays with one, two, or three in a vertical series. The infero-marginals correspond, plate to plate, with the supero-marginals; they are almost smooth in the middle and covered with papilliform granules round the edge, and are armed with from two to four stout adpressed spines, situated in a median vertical series, of which the most abactinal is the largest.

Adambulacral plates with a strongly convex furrow-margin which is armed with six or seven short, truncated, longitudinally-grooved spinelets; the actinal surface with two longitudinal series of similar spinelets—about five in each series; these spinelets are almost clavate sometimes. Mouth-plates small, very narrow, with widely open suture; each plate with a furrow-series of about ten small spinelets, the most adcentral of which is much enlarged; the actinal surface with eight or nine truncated, longitudinally-grooved spinelets in a single longitudinal series.

Actinal interradial areas large, the intermediate plates extending much more than halfway along the ray; in the interradial areas each plate has a clump of from six to eight truncated or clavate grooved spinelets; along the rays the intercalated plates have usually two longitudinal series of similar spinelets—about four in each series.

Madreporiform body small and inconspicuous or concealed, situated about midway between the centre and the margin of the disk.

Ambulacral groove very broad and open; tube-feet large, conical.

Colour in the fresh state "crushed-strawberry," sometimes with a golden suffusion; marginal plates pink, tube-feet blood-red.

Stations 107 and 109, 738 fathoms.

PSEUDARCHASTER, Sladen.

7. *Pseudarchaster mosaicus*, sp. n.

Near *P. tessellatus*, Sladen.

Rays 5. R=4 *r*.

Disk large; rays tapering; interbrachial arcs wide, rounded.

Abactinal area covered with hexagonal tabulate paxillæ, which in the centre and in the interradial areas of the disk are much smaller than elsewhere, and which on the rays are arranged in longitudinal rows, those of the central row being of predominant size. The papulæ surround the paxillæ.

The marginal plates are short and broad. The supero-marginals, about 42 in number, occupy on each side more than one third of the abactinal surface of the ray, and are uniformly covered with large granules without other armature. The infero-marginals correspond in number, size, and disposition with the supero-marginals, plate to plate, and are uniformly covered with spine-like granules, of which two or three in a longitudinal row near the suture with the supero-marginal plate are enlarged.

Ambulacral plates with a furrow-comb of five long radiating spines, and actinally two irregular longitudinal series of small spines, of which one in each series is much enlarged, except in the distal half of the ray, where one in the outer series only is enlarged; outside these is a third irregular row of very minute spinelets. Mouth-plates small and inconspicuous, each with a furrow-series of six equal moderate-sized spinelets, and with numerous irregularly arranged spinelets on the actinal surface, one of these being much enlarged.

Actinal interradial areas large, the intermediate plates extending to about the tenth infero-marginal; they are arranged in columns, and their surface is covered with spines, of which one in each plate is much enlarged.

Anal aperture small, subcentral.

Madreporiform body very small, situated midway between the margin and the centre of the disk.

Colour in the fresh state uniform pink.

Station 115, 188 to 220 fathoms.

Family **Porcellanasteridæ.**

PORCELLANASTER, Wyville-Thomson.

8. *Porcellanaster cœruleus*, Wyville-Thomson.

Porcellanaster cœruleus, Wyville-Thomson, Voy. Chall. Atlantic, vol. i. p. 378, figs. 97 and 98; Sladen, 'Challenger' Asteroidea, pp. 134–138, pl. xx.

One specimen from Station 113, 683 fathoms.

Colours in the fresh state:—Abactinal membrane dull blue, epiproctal tube and marginal plates light orange-pink, tube-feet and cribriform organs bright orange.

9. *Porcellanaster*, sp. prox. *cæruleus*, Wy.-Thoms.

Numerous small specimens from Station 111, 1664 fathoms, and Station 117, 1748 fathoms, may perhaps be the young of *P. cæruleus*. The epiproctal tube is of great length, the abactinal membrane, which is fragile, has the spinelets confined to a very narrow band in the middle of each interradial space, and the supero-marginal plates, though strongly bossed, are unarmed.

STYRACASTER, Sladen.

10. *Styracaster horridus*, Sladen.

Styracaster horridus, Sladen, 'Challenger' Asteroidea, pp. 150–152, pl. xxiii. figs. 5–7, pl. xxvii. figs. 17–20.

Specimens from Stations 117, 1748 fathoms, and 118, 1803 fathoms.

In our specimens only a few of the adambulacral plates, near the adcentral end of the ray, have four spines in the furrow-series, the majority have three, and the most distal only two. Specimens with the stomach distended show no epiproctal elevation; but those with the stomach empty have a distinct elevated cone, in one case bilobed.

Colour in the fresh state pale yellowish pink.

11. *Styracaster clavipes*, sp. n.

Agrees with *S. armatus* very closely, but differs in the following particulars:—There are five cribriform organs in each interbrachial arc; the infero-marginal plates are not much longer than broad; the terminal plate of the ray is markedly inflated; the median spines of the coalescent supero-marginal rays are comparatively short and blunt.

In general "habit" it is well distinct from *S. armatus*, Sladen, of which species there are in the 'Investigator' collection two fine specimens dredged in 1888, in 1840 to 1924 fathoms, in the Bay of Bengal.

Colour in the fresh state pale yellowish pink.

One specimen from Station 117, 1748 fathoms.

HYPHALASTER, Sladen.

12. *Hyphalaster tara*, sp. n.

Rays 5. $R = 2r$.

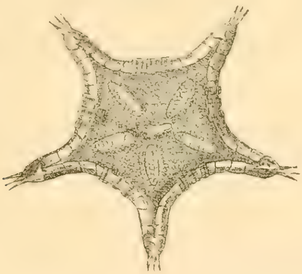
Rays short, squat, slightly inflated terminally. Disk large, strongly inflated, with a short, tapering, epiproctal tube.

Interbrachial arcs extremely wide, each with three large papillar cribriform organs.

Abactinal area covered with a toughish membrane, beset with numerous paxillæ of two kinds. Those in the middle of the radial areas of the disk are large and are surmounted by ten to fifteen or more granular spinelets; they extend in a tapering band from near the base of the epiproctal tube to near the base of the ray, and the five tapering bands show as a conspicuous rosette on the disk. The paxillæ elsewhere are small and are surmounted by but three or four spinelets. There are apparently no papulæ.

Marginal plates highly granular, unarmed, forming a perpendicular wall. Supero-marginals 6, excluding the terminal; they hardly meet in the middle line along the ray; the last plate, like the last infero-marginal, is a very small inconspicuous triangular scale, wedged in almost beneath the large upturned terminal plate; this last forms a tumid boss armed with four large acute spines. The infero-marginals correspond in number and arrangement with the supero-marginals, but are rather smaller.

Fig. 11.



Hyphalaster tara, natural size.

Adambulacral plates large, each with a furrow-series of five or six compressed lanceolate spinelets arranged in a fan-like comb. Mouth-plates large, tumid actinally, the suture widely open; the margin of each bears seven compressed lanceolate spinelets, of which the adoral one is much enlarged.

Actinal interradial areas extensive, with broad scale-like imbricating plates arranged in about nine columns parallel to the radial axis; some of the plates have small deciduous spikelets.

Ambulacral furrows broad.

Madreporiform body marginal.

Colour in the fresh state white, tube-feet pink.

Station 110, 1997 fathoms; Station 117, 1748 fathoms.

Family **Pentagonasteridæ**.

PARAGONASTER, Sladen.

13. *Paragonaster*, sp. prox. *ctenipes*, Sladen.

Young and rather mutilated examples from Station 117, 1748 fathoms.

Colour in the fresh state pale yellowish pink.

14. *Paragonaster*, sp.

A remarkable species in a mutilated condition was taken at Station 117, 1748 fathoms.

It is characterized by having the papulæ aggregated into distinctly circumscribed inflated papularia, one at the base of each ray. The paxillæ over the papularia are singularly large and prominent.

Order CRYPTOZONIA.

Family **Zoroasteridæ**.

ZOROASTER, Wyville-Thomson.

15. *Zoroaster*, sp.

A single specimen, not identifiable with any described species, was taken at Station 108, in 1043 fathoms. It has suffered so much abrasion that we are unwilling now to describe it. It is characterized by the relative smallness of the disk and great length of the rays, and by its very numerous pedicellariæ, which are of two kinds, the smaller ones occurring in clusters and bunches.

In the fresh state it was coloured orange-pink, and was covered with a thick coat of mucus.

Family **Asteriadæ**.

ASTERIAS, Linn.

16. *Asterias mazophorus*, sp. n.

Disk small, circular, marked off from the rays by a deep transverse groove. Rays long, semicylindrical, much constricted laterally at the base; their abactinal surface with small plates in longitudinal and transverse rows, the spaces between the plates being filled with papulæ in oval plots of

five to nine. The plates are covered with membrane, widely placed on which are beautiful forceps-like pedicellariæ. Near the middle of each plate is a long, stout, acute, movable spine, the base of which is buried in a large, fleshy, papillose eminence.

Marginal plates distinct, clothed and armed like the abactinals, and separated by similar groups of papulæ.

Actinal aspect of the rays almost completely occupied by the ambulacral groove, a single series of very narrow distant plates intervening between the adambulacrals and the inferomarginals. The intervals between these intermediate plates are filled each with a large papula, round which is a ring of forceps-like pedicellariæ.

Adambulacral plates very small, each armed with two spines which form a double palisade along the margin of the wide ambulacral groove. Inside this, *i. e.* within the ambulacral groove, is a more or less regular row of forceps-like pedicellariæ.

The mouth-plates are recognizable by their longer furrow-spines. In the angle of each extremely narrow interbrachial arc, behind the mouth-plate, is a crowd of pedicellariæ.

Madreporiform body rather large, radially striated.

Anal aperture indistinct.

Tube-feet quadriserial, ending in a sucker.

Colour in the fresh state deep orange-yellow, with large chestnut-brown blotches.

One specimen from Station 115, 188 to 220 fathoms.

Family **Pterasteridæ.**

Marsipaster, Sladen.

17. *Marsipaster hirsutus*, Sladen.

Marsipaster hirsutus, Sladen, 'Challenger' Asteroidea, p. 487, pl. lxxviii. figs. 3 and 4, pl. lxxix. figs. 4–6.

One small specimen with ova in the nidamental cavity.

Colour in the fresh state transparent hyaline grey.

Station 110, 1997 fathoms.

Hymenaster, Wyville-Thomson.

18. *Hymenaster nobilis*, Wyville-Thomson.

Hymenaster nobilis, Wyv.-Thoms. Journ. Linn. Soc., Zool. vol. xiii. p. 73, fig. 11; Sladen, 'Challenger' Asteroidea, p. 495, pl. lxxxvii. figs. 1–3.

A magnificent specimen, with a major diameter of nearly 8 inches, from Station 117, 1748 fathoms.

Colour in the fresh state plum-purple.

Family **Echinasteridæ.**

DICTYASTER, gen. nov.

Disk large, and flat like the short rays.

Abactinal surface covered with tough membrane, beneath which are narrow plates bearing stout spinelets, and forming a wide-meshed irregular network, the meshes of which are occupied by large groups of papulæ.

Marginal plates, especially the supero-marginals, small and inconspicuous, the infero-marginals each with a short comb of stout spines; the intervals between the plates with groups of papulæ.

Actinal interradial areas large, covered with a smooth thick membrane, beneath which is a reticulum of irregular plates.

Adambulacral armature forming a double palisade along the furrow. Tube-feet in a double row, their tips ending in a sucker.

Madreporiform body small. Anal aperture subcentral. No pedicellariæ.

19. *Dictyaster xenophilus*, sp. n.

Plectaster, sp., Wood-Mason and Alcock, Ann. & Mag. Nat. Hist. Jan. 1891, p. 14.

Rays 5. $R = 2{\cdot}5\,r$.

The whole animal invested in a thick coriaceous membrane.

Disk and rays flat and broad; interbrachial arcs wide.

Abactinal surface with narrow plates, bearing large coarse spines solitary or in rows of two or three, and forming a wide-meshed reticulum, the meshes of which are occupied by papulæ in large crowded groups.

Infero-marginal plates alone at all distinct, not in contact one with another; each bears a hinged comb of from three to five large coarse spines along its actinal margin.

Adambulacral plates covered by the general thick coriaceous investment; the narrow ambulacral groove is bounded on each side by a double series of stout palisade-like spines, those in the outer series being about half as numerous but about twice as big as those in the inner series. Mouth-plates hardly differentiated.

Actinal interradial areas large, with an irregular network of unequal plates beneath the smooth coriaceous membrane. A symbiotic Chætopod is often found on the interradial areas on which also it often lays its eggs.

Madreporiform body small, somewhat sunken, situated almost in the centre of an interbrachial arc.

Anal aperture small, subcentral.

Tube-feet in a double row, their tips ending in a sucker.

Colour in the fresh state chestnut-brown.

From Station 115, 188 to 220 fathoms.

This remarkable species has been frequently found by us in the Andaman Sea at about 250 fathoms.

Family **Brisingidæ**.

BRISINGA, Asbjornsen.

20. *Brisinga insularum*, sp. n.

Allied to *B. coronata*, Sars.

Rays 13, long, stout, with ovarian regions much inflated, and the transverse calcareous ridges well developed. Disk comparatively large.

Ambulacral tube-feet separated by a pair of horizontal spines.

Colour in the fresh state bright cinnabar-red.

Station 108, 1043 fathoms.

21. *Brisinga bengalensis*, sp. n.

Rays 14, long, slender, with hardly conspicuous ovarian inflations, and little developed transverse calcareous ridges. Disk small, margin strongly bevelled, depressed abactinally.

Ambulacral tube-feet separated by a pair of horizontal spines. Mouth-spines very long and broad, dagger-shaped, closely felted with pedicellariæ.

Colour in the fresh state bright cinnabar-red.

Station 112, 561 fathoms.

22. *Brisinga andamanica*, sp. n.

Rays 15, long, slender, with hardly conspicuous ovarian inflations, and transverse calcareous ridges little developed. Disk of moderate size.

Ambulacral tube-feet separated by a pair of horizontal

spines. Mouth-spines of moderate length, narrow, closely felted with pedicellariæ.

Colour in the fresh state bright cinnabar-red.

Station 116, 405 fathoms.

Freyella, Perrier.

23. *Freyella benthophila*, Sladen.

Freyella benthophila, Sladen, 'Challenger' Asteroidea, p. 641, pl. cxi. figs. 5–8.

Specimens from Stations 110, 1997 fathoms, and 118, 1803 fathoms.

Colour in the fresh state bright cinnabar-red.

This species was taken in 1888 in the Bay of Bengal, in 1520 and 1590 fathoms.

Class ECHINOIDEA.

Order CIDAROIDA.

Family **Cidaridæ.**

1. Porocidaris, Desor.

A small specimen with a test of 8 millim. diameter from Station 116, 405 fathoms.

Colour: madder, with white points.

Order DIADEMATOIDA.

Family **Echinothuridæ.**

2. Phormosoma, Wyville-Thomson.

Scores of fine specimens of a large species were taken in the Andaman Sea at Stations 115 and 116, in 188 to 405 fathoms.

Family **Arbaciidæ.**

Podocidaris, A. Agassiz.

3. *Podocidaris ? prionigera*, A. Agassiz.

Porocidaris prionigera, A. Agassiz, 'Challenger' Echinoidea, p. 59, pl. xxxiv. figs. 14 and 15.

Specimens from Station 112, 561 fathoms.

The same species was dredged in the Bay of Bengal at 1590 fathoms in the year 1888.

Family **Temnopleuridæ** (?).

Prionechinus, A. Agassiz.

4. *Prionechinus Agassizii*, sp. n.

This species differs from *Prionechinus sagittiger* in the following particulars:—The test is thick; there are five complete pairs of buccal tentacles; and the ambulacral plates have three pairs of pores and one primary tubercle to each plate. The pairs of pores are in one simple vertical series in triplets concentric with their tubercle, so as to be slightly wavy, especially below the ambitus, where in the region of the actinostome they are very distinctly zigzag.

Both ambulacra and interambulacra are made up of two rows of simple plates, those of the ambulacra being of the same height, but only between one half and one third the breadth of those of the interambulacra.

The median interambulacral grooves and the slightly depressed poriferous zones divide the test into segments like those of a peeled orange.

Diameter of test 13·8 millim., of actinostome 6·5 millim., of periproct 3 millim.

From Station 111, 1644 fathoms.

Two fine specimens were dredged in the Bay of Bengal, at 1840 fathoms, in the year 1888.

Order SPATANGOIDA.

Family **Spatangidæ**.

Homolampas, A. Agassiz.

5. *Homolampas glauca*, sp. n. (Pl. XVII.)

Differs from *Homolampas fulva*, A. Agassiz, (1) in being more depressed, (2) in having the posterior end of the test truncate and unnotched, and (3) in the narrower ventral plastron.

Colour in the fresh state brownish green.

Four specimens from Station 111, 1644 fathoms, the largest measuring 93 millim. in length.

Class HOLOTHUROIDEA.

Of Holothurians very numerous specimens of twelve species and nine genera were obtained, and they have in large part been identified by Surgeon I. H. Tull Walsh, I.M.S., who has given a list of most of the 'Investigator' deep-sea Holothuroidea in the Journ. As. Soc. Beng. vol. lx. pt. ii., 1891, pp. 197–204, to which we refer for names of species and notices of two new genera.

In the Andaman Sea *Benthodytes* appears to live in large colonies at moderate depths; and besides *Benthodytes*, *Pannychia*, *Eupyrgus*, and a new type of Deimatidæ, according to Mr. Walsh, were found.

On the *Globigerina*-ooze of the greater depths of the Bay of Bengal Holothurians, especially of the bathybial order Elasipoda, seem to find an optimum, and specimens of the following were trawled:—*Peniagone* (1803 fathoms), *Deima*, two species (1644 to 1803 fathoms), *Orphnurgus* (561 fathoms), *Euphronides* (1803 fathoms), *Benthodytes*, two species (1748 to 1803 fathoms), and *Apodogaster* (561 fathoms), the last being a new genus of the Psychropotidæ established by Mr. Walsh.

In the Laccadive Sea numerous Holothurians were taken between 738 and 1091 fathoms—*Deima*, *Benthodytes*, and *Eupyrgus*.

Class OPHIUROIDEA.

Of this class numerous specimens, of thirteen species and seven genera, were collected.

In the Andaman infra-littoral down to 400 fathoms, just as in the Andaman littoral zone, brittle-stars have been found to be in this, as in previous seasons, very numerous, especially where the bottom contains many *Globigerina*-shells and much coral-detritus. A beautiful pink *Ophiothrix* is very common here, the swabs often coming up completely encrusted with it.

In the opener parts of the Bay of Bengal, where, along with increasing depth and distance from land, the bottom comes to be made up largely of the shells of Foraminifera, a good many Ophiuroids were taken, up to the greatest depth in which the trawl was worked.

In the Andaman Sea, besides the multitude of *Ophiothrix*, were found *Ophioglypha* (405 fathoms) and a beautiful species of *Ophiernus* with disk of deep purple and rays of bright scarlet (683 fathoms).

In the Bay of Bengal four species of *Ophioglypha* were taken in 561 to 1803 fathoms, two species of *Ophiomusium* in 1748 to 1997 fathoms, a species of *Ophiomastus* in 1997 fathoms, and two species of *Ophiacantha* in 1644 to 1803 fathoms.

In the Laccadive Sea brittle-stars were seldom seen ; two good specimens of the same beautiful purple and scarlet *Ophiernus* as that recorded from the Andaman Sea were taken in 1043 fathoms, and a single small specimen of a species of *Amphiura* in 1091 fathoms.

Class **CRINOIDEA.**

On muddy bottoms in the Andaman Sea some small and rather damaged specimens of two species of Comatulæ were trawled. These were *Eudiocrinus,* from 922 fathoms, and *Antedon*—a ten-armed species—from 188 to 220 fathoms.

Phylum **MOLLUSCA.**

Branch A. Glossophora.

Class **GASTROPODA.**

Family **Naticidæ.**

1. *Sigaretus,* sp.

Numerous specimens were found at Station 119, in 95 fathoms, and a few at Station 120, in 240 fathoms. This species is characteristic of the infra-littoral of the Bay of Bengal at and near the 100-fathom line from the Mahánadi to the Kistna. The operculum is without a basal prolongation.

2. *Natica* (*Naticina*), sp.

Specimens were met with in the Andaman Sea at 405 fathoms, in the Bay of Bengal in 240 to 276 fathoms, and in the Laccadive Sea at 738 fathoms. This species has twice been found in the stomach of a starfish.

3. *Natica,* sp.

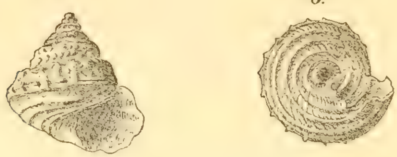
Three dead shells from the Andaman Sea, 683 fathoms.

Family **Trochidæ**.

4. *Solariella metallica*, sp. n.

A brilliantly nacreous species, ornamented with two spiral rows of conical tubercles and four smooth carinæ on the base, exclusive of a faintly granulated one which bounds the umbilicus. From 738 fathoms in the Gulf of Manaar (Station 109). The glistening metallic lustre of the whole exterior is largely though not entirely due to the erosion of the delicate external layer of the shell.

Fig. 12.



Solariella metallica.—*a*, from the front; *b*, from the base. Natural size.

Family **Strombidæ**.

5. *Rostellaria delicatula*, Nevill.

Rostellaria delicatula, Nevill, Journ. As. Soc. Beng. vol. l. (1881) pt. 2, p. 262; Wood-Mason and Alcock, Ann. & Mag. Nat. Hist. (6) vii. p. 16.

Many specimens in various stages of growth from Station 119, 95 fathoms.

This form, already noticed to be characteristic of the Bay of Bengal infra-littoral at and near the 100-fathom contour from Arrakan to the Godávari, is now found off the Kistna Delta, about seventy miles further south.

Family **Pleurotomidæ**.

6. *Pleurotoma symbiotes*, sp. n.

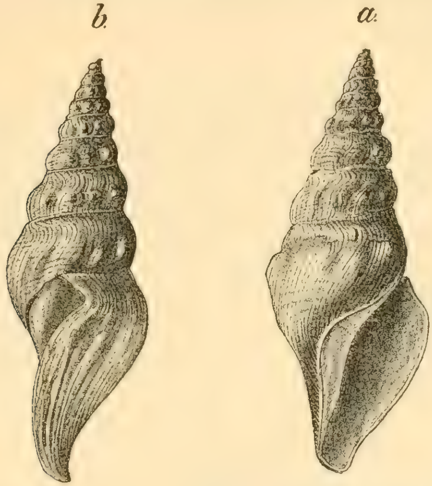
Two living specimens from the Laccadive Sea, 1043 fathoms (Station 108).

They were encrusted all over with an *Epizoanthus*.

The shell is remarkable for its peculiar glistening white

outer layer, with which is most beautifully contrasted the pale cinnamon interior.

Fig. 13.



Pleurotoma symbiotes.—*a*, from in front; *b*, from the side. Natural size.

Dead and eroded shells of four species of Pleurotomids were taken at the following stations:—112, 561 fathoms; 113, 683 fathoms; 115, 188 to 220 fathoms.

Family **Pterotracheidæ.**

7. *Carinaria*, sp.

At Station 118, 1803 fathoms. Probably from the surface.

Family **Pleurobranchidæ.**

8. *Pleurobranchus*, sp.

At Station 116, in 405 fathoms, a species coloured dark purple.

Family **Pleurophyllidiidæ.**

9. *Pleurophyllidia*, sp.

At Station 120, 240 to 276 fathoms.

Class SCAPHOPODA.

Dead shells of two species of (10) *Dentalium* and of a species of (11) *Cadulus* were dredged at Station 113 in the Andaman Sea.

Class CEPHALOPODA.

Specimens of three species of Cephalopods were obtained, namely (12) *Cirroteuthis*, in the Gulf of Manaar, at 738 fathoms; (13) *Inioteuthis*, in the Andaman Sea, at 188 to 120 fathoms; and (14) a *Loligo*-like form from the same station.

The *Cirroteuthis* was jet-black in colour during life, and imparted to the spirit in which it was preserved a purple hue, which has permanently stained the paper label accompanying the animal.

The *Inioteuthis* was of an iridescent purple and green colour in life.

Branch B. LIPOCEPHALA.

Class LAMELLIBRANCHIATA.

Family **Pectinidæ.**

15. *Amussium*, sp.

Specimens of *Amussium* were obtained in the Andaman Sea at 683 and 922 fathoms, in the Bay of Bengal at 561, 1748, and 1803 fathoms, and in the Laccadive Sea at 738 fathoms. They appear to belong to four species.

Family **Arcidæ.**

16. *Arca* (*Barbatia*), sp. conf. *pteroessa*, Smith, or *ectobarbata*, Dall.

Five specimens from Station 111, 1644 fathoms.

17. *Limopsis*, sp.

Two species were dredged, one in the Andaman Sea in 683 fathoms, the other in 1043 fathoms in the Laccadive Sea.

Family **Ledidæ.**

18. *Malletia*, cf. *arrouana*, Smith.

From the Laccadive Sea at 1091 fathoms.

Family **Cuspidariidæ.**

19. *Cuspidaria*, sp.

Four species, all from the Andaman Sea between 188 and 405 fathoms.

Family **Verticordiidæ.**

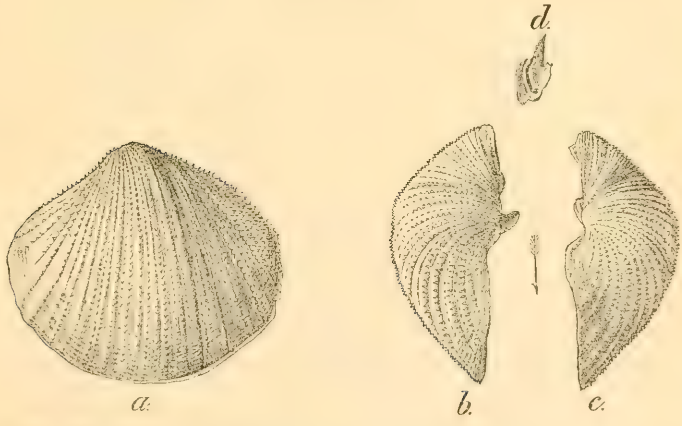
20. *Verticordia* (*Euciroa*) *eburnea*, sp. n.

Allied to *Euciroa elegantissima*, Dall.

The shell in the dry state is of a beautiful ivory-white externally, discoloured slightly at the ventral margin by the epidermis; internally it rivals *Trigonia* in its pearly lustre.

The external surface is traversed from beak to ventral margin with numerous ridges which bear sharp fluted conical spinelets. These ridges are best and most regularly developed about the middle of the shell, being few and wide apart and ventrally incomplete anteriorly, while posteriorly they are irregularly crowded together. The intervals between

Fig. 14.



Verticordia (*Euciroa*) *eburnea*.—*a*, from the left side; *b*, dorsal view of the right valve; *c*, the same of the left valve; *d*, ossicle still attached to the ligament of the right valve. All natural size.

the ridges are finely granulated. The left valve is slightly smaller than the right, into which it fits ventrally, and has only one tooth—a posterior lateral. The right valve has a posterior lateral tooth, which is anterior to that of the opposite

valve, and an anterior tooth in the form of a broad and stout-based projecting massive hook, which is received into a notch of the left valve lying beneath the umbo between the ligamentary fossa and the lunule. Except for a mere film joining the valves externally in the usual position the ligament is internal. A stout, convex, posteriorly-bifid ossicle connects the ligaments of the valves with one another.

Most striking is the curious lunule, which suggests in-turned ears.

A fine living specimen from Station 115, 188 to 220 fathoms, measuring in length 37 millim., in height 33·2 millim., and in thickness 26·8 millim.

21. *Verticordia*, sp.

From the Bay of Bengal, in 1997 fathoms.

Family **Tellinidæ**.

22. *Tellina*, sp.

Two species were dredged, one from the Bay of Bengal at 561 fathoms, the other from 922 fathoms in the Andaman Sea.

Subgrade *CŒLENTERATA*.

Phylum **NEMATOPHORA**.

Class **SCYPHOMEDUSÆ**.

Order PEROMEDUSÆ.

Family **Periphyllidæ**.

PERIPHYLLA, Steenstrup.

1. *Periphylla*, sp.

A large species, with the internal organs rather ragged, from Station 120, 240 to 276 fathoms.

Order DISCOMEDUSÆ.

Family **Ephyridæ** (COLLASPIDÆ).

ATOLLA, Hæckel.

2. *Atolla Wyvillii*, Hæckel.

Atolla Wyvilli, Hæckel, 'Challenger' Deep-sea Medusæ, pp. 113–123, pl. xxix.

Two specimens from Station 116, 405 fathoms, and one from Station 120, 240 to 276 fathoms.

Class **ANTHOZOA.**

Subclass **ALCYONIOMORPHA.**

Order PENNATULIDA.

At Station 115, 188 to 220 fathoms, a fine specimen of a *Pennatula* was obtained; it is of a remarkable rich orange colour, the pigment being insoluble in alcohol.

At the same Station was dredged a large specimen of an *Umbellula* near to *U. Carpenteri*, Kölliker.

At Station 118, in 1803 fathoms, some small specimens of an *Umbellula* of a bright pink colour occurred.

Subclass **ACTINIOMORPHA.**

Order ACTINIARIA.

Family **Actinidæ.**

Eight species of bathybial Actiniaria were obtained during the season between 240 and 1997 fathoms. Among them is an *Epizoanthus* encrusting a shell of a living Pleurotomid, from the Laccadive Sea; and a remarkable rigid cup-shaped form with a non-retractile peristome, from the mud of the Bay of Bengal.

Order MADREPORARIA.

MADREPORARIA APOROSA.

Family **Turbinolidæ.**

FLABELLUM, Lesson.

1. *Flabellum japonicum*, Moseley.

Flabellum japonicum, Moseley, 'Challenger' Deep-sea Madreporaria, p. 168, pl. vii. figs. 3, 3 *a*, pl. xvi. fig. 12.

A series of ten specimens (five living and five dead)—the smallest of which measures ·95 by ·85 of an inch, the largest 3 by 2·25 inches in the diameters of the calicular orifice—was taken at Station 109, 738 fathoms.

In the smaller specimens the corallum is wide and shallow, with the primary and secondary costæ well marked, the columella abundant and formed of contorted fascicles, the fifth

cycle of septa incomplete and inconspicuous, and the pedicle very prominent.

In the larger specimens the calicle is deep and more compressed, the primary and secondary costæ are inconspicuous, while in the other cycles in place of costæ there are shallow furrows, the columella is a small smooth dense plug in the very bottom of the calicle, the fifth cycle of septa is complete, and the pedicle is a small obtuse point.

The difference between the two extremes is so marked that, but for the possession of a fairly well-graded series, it might fairly have been regarded as specific. The inside of the dry corallum is, like the soft tissues of the polyp, of a dark madder-colour.

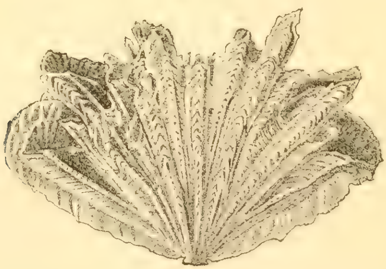
2. *Flabellum laciniatum*, Philippi.

Phyllodes laciniatum, Philippi, Neues Jahrb. für Mineral. &c., 1841, pp. 663 and 664, pl. xi. B. fig. 2.
Flabellum laciniatum, Edw. & H., Ann. Sci. Nat. (3) ix. p. 273; Hist. Nat. Corall. ii. p. 92.
Flabellum laciniatum, Seguenza, Mem. Ac. Torin. (ii.) xxi. p. 485, tav. x. fig. 7.
? *Flabellum laciniatum*, Duncan, Proc. Roy. Soc. xviii. p. 293; id. Trans. Zool. Soc. viii. p. 323, pl. xxxix. figs. 11, 14–18.
? *Flabellum laciniatum*, Lindström, Svensk. Ak. Handl. xiv. ii. p. 12.

A single specimen, in very fair preservation, from Station 116, 405 fathoms, which we name with some confidence from Philippi's description.

We are not able, however, to identify it with Prof. Martin Duncan's figures, which appear to represent young and therefore not unequivocally determinable forms of *Flabellum*.

Fig. 15.



Flabellum laciniatum, Phil., natural size.

We agree with Prof. Moseley ('Challenger' Deep-sea Madreporaria, p. 170) in considering that his *Flabellum ala-*

bastrum is specifically quite distinct from *Flabellum laciniatum*. In the latter the calicle is more wedge-shaped, not laterally compressed in the middle, and less conspicuously pedunculate, and its margin is much more deeply indentated between the septa; the columella is a mere rudiment in the bottom of the calicle, and the lateral costæ are much more nearly horizontal and are extremely prominent, forming with their corresponding septa conspicuous lateral wings. The dry corallum, like the living polyp, is of a dark madder-colour.

Our specimen measures about 2 inches in the major and 1·2 in the minor diameter of the calicular orifice.

Phylum **PORIFERA.**

Class **SILICOSPONGIÆ.**

In the Andaman Sea, Station 115, 188 to 220 fathoms, proved a harvest-field for Sponges, as for Fishes, Crustaceans, and Echinoderms. Here a large number of *Hexactinellida* was obtained, including numerous huge specimens, over two feet in length, of a *Semperella*, a large *Pheronema*, and two species of *Hyalonema*.

The depths of the Bay of Bengal yielded many Hexactinellid forms, among which we recognize (1) an Asconematoid forming a thin-walled, shallow, broad-lipped cup, composed of a felt of long spicules, from 1997 fathoms, (2) a fine specimen of an *Aulochone* from 1803 fathoms, (3) a small *Hyalonema* from 1997 fathoms, and (4) several species of Euplectellids.

Grade A. PLASTIDOZOA.

Class **RETICULARIA.**

In such examination as has been made of the ocean-deposit brought up by the sounding-tube and trawl during the season the only notable Foraminifer discovered is a large species of *Hormosina*, which combines some of the characters of *Hormosina ovicula*, H. B. Brady, with some of those of *Hormosina monile*, H. B. Brady. The test, which is long, slender, and tapering, is composed of numerous subpyriform segments arranged in a straight line in a very close-set diminishing series; the walls are smooth, thick, and strong, with a compact finely arenaceous texture; colour red-brown.

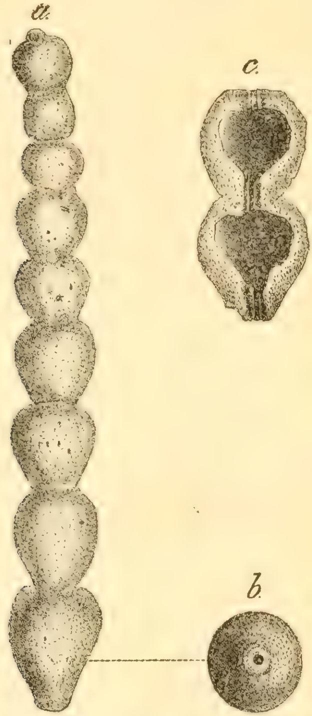
The largest fragment measures 8·5 millim. in length.

The cavities of the chambers have the form of a short, flat-topped pear.

Several specimens from the Bay of Bengal at 561 fathoms (Station 112).

For this species we propose the name *Hormosina Bradyi*, after our late friend Dr. H. B. Brady, F.R.S.

Fig. 16.



Hormosina Bradyi.—*a*, lateral view; *b*, oral view; *c*, two consecutive chambers in longitudinal section. ×.

EXPLANATION OF PLATE XVII.

Fig. 1. *Homolampas glauca*, from the abactinal side. Nat. size.
Fig. 2. Ditto, from the actinal side. Nat. size.

[To be continued.]

LIII.—*Notes on American Batrachians.* By G. A. Boulenger.

Rana cantabrigensis, Baird.

I have no hesitation in pronouncing *R. cantabrigensis latiremis*, *R. c. cantabrigensis*, and *R. c. evittata* of Cope (Batr. N. Am. 1889, p. 435) to represent *individual* variations of one species, which, as I have stated before (Bull. Soc. Zool. France, 1879, p. 162), is the North-American representative of the European *R. arvalis*. The first "form" represents the breeding male, the second the striped individuals, the third the specimens without stripes, females and males *post nuptias*. The establishment of "subspecies" or "varieties" of this kind, and such innovations as the reference of *R. aurora* to *R. agilis*, are not likely to advance our knowledge, and I must frankly say it is a matter of regret that the extensive material in the United-States Museum should not have received more careful treatment at the hands of Prof. Cope, who does not even take the trouble of ascertaining the sexes of the specimens he describes.

The whole question of the North-American *Ranæ temporariæ* is much in want of a thorough revision. In the meanwhile, after studying Cope's latest work, I adhere to my former classification of the North-American forms in four species, viz.:—1. *R. Draytoni*, B. & G.* (=*aurora*, B. & G., *nigricans*, Hallow., *Boylii*, Baird, *longipes*, Hallow., *pachyderma*, Cope); 2. *R. pretiosa*, B. & G.; 3. *R. cantabrigensis*, Baird; 4. *R. silvatica*, Leconte.

Rana palmipes, Spix.

Rana clamata, var. *guianensis*, Peters, Mon. Berl. Ac. 1863, p. 412, is another name to add to the synonymy of this species.

Engystoma carolinense, Holbr.

I have examined the type specimen of *Engystoma rugosum*, D. & B., and refer it to *E. carolinense*.

Leptodactylus prognathus, Blgr.

Three specimens from Buenos Ayres are preserved in the Copenhagen Museum.

* 1852, not 1862, as misprinted in my Catalogue and again in Cope's work.

Paludicola signifera.

Rhinoderma signifera, Girard, Proc. Ac. Philad. 1853, p. 424, and U.-S. Explor. Exped., Herp. p. 72 (1858).
Liuperus biligonigerus, Cope, Proc. Ac. Philad. 1860, p. 517.
Gomphobates notatus, Reinh. & Lütk. Vid. Middel. 1861, p. 173, pl. iv. fig. 3.
Gomphobates Kröyeri, Reinh. & Lütk. *l. c.* p. 176.
Pleurodema biligonigera, Cope, Proc. Ac. Philad. 1862, p. 352.
Leiuperus albonotatus, Steind. Verh. zool.-bot. Ges. Wien, 1862, p. 272, pl. xvi. fig. 4, and p. 551.
Leiuperus ephippifer, Steind. *l. c.* p. 277, pl. xiv. fig. 1, and pl. xvi. fig. 5.
Gomphobates biligonigerus, Cope, Proc. Am. Phil. Soc. xi. 1869, p. 168.
Paludicola notata, Peters, Mon. Berl. Ac. 1872, p. 223.
Paludicola biligonigera, Bouleng. Cat. Batr. Ecaud. p. 234 (1882).
Paludicola Kröyeri, Bouleng. *l. c.* p. 235.

Hundreds of specimens, from Santa Catharina and Parana, have lately passed through my hands, and show beyond doubt that *P. Kröyeri*, R. & L., is only a variety of the species named *Rhinoderma signifera* by Girard and *Liuperus biligonigerus* by Cope. Some specimens are smooth, others are covered with warts, others have the longitudinal folds characteristic of *P. Kröyeri*; some have the snout rounded, others have it pointed; some are uniformly coloured on the back, others are marked with insuliform spots, whilst others, again, are striped. But all these differences are completely bridged over when a large series, from the same locality, are examined. The inguinal spots, which are rarely absent, are constantly small and uncovered by the folded limbs. The metatarsal tubercles are larger and more compressed than in *P. gracilis*, and the tibio-tarsal articulation does not reach beyond the posterior border of the orbit.

Borborocœtes miliaris.

Rana miliaris, Spix, Spec. Nov. Test. Ran. Bras. p. 30, pl. vi. fig. 1 (1824).
Cystignathus Missiessii, Eyd. & Soul. Voy. 'Bonite,' Zool. i. p. 148, pl. x. fig. 2 (1841).
Cystignathus discolor, Reinh. & Lütk. Vid. Meddel. 1861, p. 169.
Thoropa Missiessii, Cope, Nat. Hist. Rev. 1865, p. 110.
Ololygon abbreviatus, Steind. Novara, Amph. p. 65, pl. iv. figs. 16–18 (1867).
Hylodes abbreviatus, Hens. Arch. f. Nat. 1867, p. 151.
Ololygon miliaris, Peters, Mon. Berl. Ac. 1872, p. 206.
Thoropa miliaris, Bouleng. Cat. Batr. Ecaud. p. 331 (1882).

Prof. Lütken having kindly communicated to me the type specimens of *Cystignathus discolor*, I come to the conclusion that that species is not different from *Ololygon miliaris*, of

which I examined the specimen in the Berlin Museum. I further find that *Ololygon* or *Thoropa miliaris* is not a Hyloid but a Cystignathoid, and that it agrees in all essential points with *Borborocœtes*, Bell. The diapophyses of the sacral vertebra are feebly dilated, just as in *B. Bibronii*, *Grayi*, and *quixensis.* I append a description taken from the specimens in the Berlin and Copenhagen Museums.

Tongue subcircular, slightly nicked behind. Vomerine teeth in two short transverse series on a line with the posterior border of the choanæ. Snout rounded, as long as the diameter of the orbit; canthus rostralis obtuse, loreal region concave; nostril much nearer the end of the snout than to the eye; eye large; interorbital space as broad as the upper eyelid; tympanum very distinct, two thirds or three fourths the diameter of the eye. Fingers moderate, first slightly longer than second; toes moderate, quite free, not fringed; subarticular tubercles moderately developed; two metatarsal tubercles, inner elliptical, outer round. The tibio-tarsal articulation reaches the tip of the snout or a little beyond. Skin smooth, with a few glandular warts on the sides; a strong fold from the eye to the shoulder. Pale greyish or brownish above, with darker marblings; a large triangular spot, base forwards, between the eyes; a blackish line along the canthus rostralis and temporal fold; hind limbs with dark cross bars; hinder side of thighs dark brown, with yellowish spots; lower parts pale brown, throat and belly dotted with yellowish.

From snout to vent 45 millim.

Cystignathus hylodes, described in the same paper with *C. discolor* by Reinhardt and Lütken, is based on young specimens of *Leptodactylus pentadactylus.*

Bufo Luetkenii, sp. n.

Intermediate between *B. valliceps*, Wiegm., and *B. granulosus*, Daud. Crown deeply concave, with prominent ridges, viz. a canthal, a preorbital, a supraorbital, a postorbital, a parietal, and an orbito-tympanic; parietal ridges short, oblique, directed inwards; snout rounded, not prominent; interorbital space at least as broad as the upper eyelid; tympanum very distinct, two thirds or three fifths the diameter of the eye. First finger considerably longer than second; toes half-webbed, with single subarticular tubercles; two small metatarsal tubercles; no tarsal fold. The tarso-metatarsal articulation reaches the tympanum or the eye. Upper parts with small irregular warts; parotoids very small, oval,

oblique, not much larger than the tympanum. Brown above, with or without yellowish spots; dirty white below, without any spots. Male with a subgular vocal sac and the usual copulatory asperities on the three inner fingers.

From snout to vent 82 millim.

Prof. Lütken has submitted to me three specimens obtained by A. S. Oersted at Cartago, Costa Rica. One of these specimens is now in the British Museum.

Hyla nana, Blgr.

Has been received from Rio Grande do Sul through Dr. v. Ihering.

Hyla bivittata, Blgr.

A specimen of this species was among a collection made on the Tibagy River, Province Parana, by Dr. G. F. Grillo, and submitted to me by the Marquis G. Doria.

Hylella Sumichrasti.

Exerodonta Sumichrasti, Brocchi, Bull. Soc. Philom. (7) iii. 1879, p. 20, and Miss. Sc. Mex., Batr. p. 48, pl. xv. fig. 2 (1882).
Hylella platycephala, Cope, Proc. Am. Phil. Soc. xviii. 1879, p. 269.

The above names apply to the same species and were published in the same year. Brocchi's paper was read first and apparently appeared before Cope's.

Diaglena Jordani, Stejneger.

Vol. xiv., now in course of publication, of the 'Proceedings of the U.S. National Museum,' contains (p. 167, pl. iii.) the description of a new tree-frog for which Mr. Stejneger proposes the new genus *Tetraprion*, allied to *Triprion* and *Diaglena*, differing from all others in the simultaneous presence of vomerine and palatine teeth. *Triprion spatulatus*, the type of Cope's genus *Diaglena* (Bull. U. S. Nat. Mus. no. 32, 1887, p. 12), was described by Günther (Ann. & Mag. Nat. Hist. 5, x. 1882, p. 279) from living specimens; the dentition was therefore not examined. I may now state that it has the palatine teeth situated as in *Tetraprion Jordani*, which, in the absence of any other character of generic importance, should stand as *Diaglena Jordani*.

Siphonops brasiliensis.

Siphonops brasiliensis, Lütk. Vid. Meddel. 1851, p. 54 (1852); Reinh. & Lütk. Vid. Meddel. 1861, p. 202.

I find on examination of the type specimen, kindly entrusted to me by Prof. Lütken, that *Siphonops brasiliensis* belongs to that genus in the restricted sense, not to *Dermophis*, as suggested by Peters. The shape of the tentacle is exactly as in *Siphonops annulatus*, and so is its position with respect to the eye, which is very indistinct; the dentition does not differ, so far as I can judge from the condition of the specimen. The more prominent snout and the much more elongate body easily distinguish *S. brasiliensis* from *S. annulatus*, and the position of the tentacle separates it from *S. Hardyi*, as may be seen from the following synopsis:—

Tentacle in front of and below the eye, which is perfectly distinct; diameter of body about 25 times in the total length; 85 to 95 circular folds, all complete .... 1. *S. annulatus*, Mik.

Tentacle in front of and below the eye, which is very indistinct; diameter of body 46 times in the total length; 133 circular folds, mostly interrupted on the back and belly .... 2. *S. brasiliensis*, Lütk.

Tentacle in front of and close to the eye, and very slightly below; eye more or less distinct; diameter of body 36 or 37 times in the total length; 100–104 circular folds, all complete.... 3. *S. Hardyi*, Blgr.*

Typhlonectes Kaupii.

Siphonops Kaupii, Berthold, Götting. Nachr. 1859, p. 181, and 1867, p. 361.
Cœcilia dorsalis, Peters, Mon. Berl. Ac. 1877, p. 459, pl. —.
Typhlonectes dorsalis, Peters, Mon. Berl. Ac. 1879, p. 941.

The earlier name *S. Kaupii*, which evidently applies to the same species as that named *C. dorsalis* by Peters, has hitherto been overlooked.

* The British Museum has recently received two more specimens of this species, from M. Hardy du Dréneuf.

LIV.—*Descriptions of new Species of* Madrepora *in the Collection of the British Museum.* By GEORGE BROOK, F.L.S.

DURING the examination of the collection of Madrepores in the British Museum I have found a number of specimens which, after careful comparison with types contained in other European Museums, seem to me to be undescribed. In anticipation of a fuller detailed account of the species of this family, I offer the following abridged descriptions of the new species.

Madrepora Brueggemanni.

Madrepora laxa, Brüggemann (non Lamarck), Abh. naturw. Ver. Bremen, Bd. v. 1877, p. 544.

Corallum spreading, arborescent, laxly branched. Main branches stout, 2 to 3 centim. thick, elongate or short and obtuse. Elongate branches 15 centim. long and 1·5 centim. thick, little divided, scarcely tapering, except near the apex; stunted form of similar diameter, more frequently and divaricately divided; ultimate divisions 2 to 3 centim. long, 1 to 1·5 centim. thick, scarcely tapering, very obtuse at the apex. A few short conical buds or abortive branchlets are scattered at intervals from the base upwards. Corallum rather dense, surface strongly echinulate. Apical corallites very variable in size, sometimes 4 to 6 millim. in diameter, with very thick wall, not exsert or only slightly so; at others conical, 2 millim. exsert, 4 to 5 millim. diameter at the base and about 3 millim. at the apex. In certain cases, where the terminal divisions are very stout, a single apical corallite does not occur, but, instead, the apex is occupied by several stout cylindrical corallites, with only the rounded margin prominent. This clearly is an approach to the condition in the subgenus *Isopora.* Lateral corallites crowded, very unequal and irregular on the upper surface, but distant below; short, thick, spreading, tubular, with small aperture and rounded margin, 2 to 2·5 millim. diameter and 2 to 5 millim. long, but most are short. At intervals certain corallites become more elongate and thickened and form buds. The inner part of the wall is often not so thick and prominent, in which case the aperture opens inwards, and the outer part of the wall may project in a point or hooked knob some distance above it. This type of corallite is most frequent in certain elongate

branched specimens which probably constitute a distinct variety. Star well developed, primary septa broad and sub-equal, the others not so prominent; wall finely and closely granular, echinulate, the echinulate plates often arranged in rows at the base of the corallites. Immersed corallites are not numerous, and occur only on the under surface of the branches.

Indo-Pacific Ocean; Singapore; N.E. Australia.

Madrepora clathrata.

Corallum fan-shaped, reticulate, 30 centim. high, breadth across the upper part 33 centim., but becoming rapidly narrower below. A main stem is absent and the branches in the lower part have a diameter of about 1 centim.; their subdivisions are at first only slightly spreading, but become more divaricate above. The branchlets are numerous, 2 to 4 centim. long and 5 millim. thick, frequently arched and laid across one another at various angles, the whole fused together into an irregular network, the meshes of which vary from 4 to 12 millim. across. Apical corallites 2 millim. diameter, 1 to 2 millim. exsert, wall rather thick and cylindrical, with a flat or slightly rounded apex; the star consists of six sub-equal septa of moderate development. Lateral corallites on the anterior (superior?) surface very unequal, not very crowded; the larger ones tubular, at right angles, with an oblique aperture, from 3 to 4 millim. long and about 2 millim. diameter, but frequently a little compressed; a few are longer and proliferous, the remainder are less spreading, shorter, tubular, tubo-nariform, and nariform to subimmersed; the only truly immersed corallites on the upper surface occur in the lines of fusion. Star imperfect, the directive septa moderately developed, but the others are rudimentary or wanting. The lateral corallites on the posterior (inferior?) surface are distant, very short, chiefly subimmersed or cochleariform. Corallum very porous, surface closely reticulate and echinulate, the echinulations often plate-like. Wall of the apical corallites and of the elongate lateral ones costate above, the costæ being echinulate below; wall of the remaining lateral corallites echinulate in rows.

Indian Ocean; Mauritius.

Madrepora complanata.

Corallum flabellate, probably about 23 centim. high and 40 centim. broad. The main stem gives off alternate branches

at an acute angle which may be 20 centim. long and 1·5 centim. thick, spreading out laterally, their subdivisions subalternate and confluent, the whole habit recalling the espalier form of fruit-tree; a few very short branchlets arise obliquely from the anterior surface, but the majority conform to the general plane of growth. Apical corallites 2 to 2·5 millim. diameter, tubular, scarcely exsert, wall not specially thickened, and closely resembling the lateral ones except in shape. Lateral corallites on the anterior surface subequal, very spreading, boat-shaped, nariform, or labellate, the aperture wide and elongate, the upper margin almost at right angles to the branch, the lower more or less convex; wall thickened, apex often a little hooked; 2·5 millim. long and about 2 millim. thick. The corallites become a little less prominent towards the base of the corallum, but immersed corallites are practically absent. On the inferior surface the corallites are more scattered and irregularly arranged, many open downwards, the majority are appressed, tubular, with only the outer part of the wall free. A few immersed corallites occur, but they are neither numerous nor generally distributed. Corallum moderately porous, reticulate in section, anterior surface subreticulate and echinulate, posterior surface dense and finely echinulate, wall finely striate and echinulate. The lateral corallites have six very narrow equal septa, with occasionally indications of a second series.

Indian Ocean; Seychelles.

Madrepora concinna.

Corallum corymbose, 30 centim. broad and 12 centim. high, from a central base, scarcely pedicellate. Under surface of the branches horizontal, much flattened, more or less confluent, 9 centim. long and 2 centim. broad, provided with irregular verruciform and lateral, elongate, tubular or conical corallites; immersed ones almost absent. Branches on the upper surface 5 to 6 centim. long, 8 to 13 millim. thick, very proliferous. Apical corallites 3·5 millim. diameter at the base, tapering, 3 millim. exsert. Lateral corallites very unequal; those at the apex are very short, small and thin-walled, others immediately below tubo-nariform or tubular, with a round or oblique aperture, frequently opening inwards; some are 3 to 6 millim. long and 2 to 3 millim. in diameter, spreading, but not at right angles, wall thick, margin rounded; others between are shorter or subimmersed; all are short or subimmersed at the base of the branches. Star not prominent, consisting of narrow directive septa and four others which are

rudimentary. Corallum dense, surface and wall finely echinulate.

Mauritius.

Madrepora delicatula.

Corallum extending horizontally, branches not over 8 millim. thick, laxly coalescent, but not complanate, and bearing on the under surface numerous slender branchlets almost at right angles, 1 centim. or more in length and generally 2·5 millim. diameter at the base, with distant appressed tubular buds. Appressed tubular and immersed corallites also occur between the twigs. The upper surface bears slender arcuate branches not over 5 millim. thick, which give rise to delicate ascending branchlets singly or in groups of two or three; these are 1·5 to 2·5 centim. long and scarcely 3 millim. thick at the base, apparently tapering, owing to the lateral corallites being shorter near the apex. Apical corallites 1·5 millim. diameter, usually 2·5 millim. exsert. Lateral corallites rather distant, round-nariform, or labellate, 1 to 1·3 millim. wide and 1 to 4 millim. long; the lip of the more elongate ones is frequently a little incurved; wall thin, aperture round, star indistinct. Corallum very porous and fragile, surface vermiculato-echinulate, wall finely striate, echinulate near the base.

Solomon Islands (*Dr. Guppy*).

Madrepora diversa.

Corallum cespitose from a broad incrusting base, 10 centim. high and 18 centim. broad. Branches 4·5 centim. long, 1·3 to 1·8 centim. thick, simple or divided into two to five little spreading digitiform branchlets about 2·5 centim. long and 1 centim. thick, obtuse at the apex. Apical corallites 3·5 to 4 millim. broad, scarcely exsert. Lateral corallites chiefly tubular, with a more or less oblique aperture, very unequal in length and diameter, all are ascending. The larger ones are 3 to 6 millim. long and 2 to 2·5 millim. diameter, slightly compressed; wall thick, but only slightly rounded at the margin; smaller nariform and subimmersed corallites occur between the others quite to the apex; a few are proliferous and 5 to 8 millim. in length. About 2 centim. below the apex the prominent corallites are nariform or tubonariform, with a thick and strongly convex outer wall; at the base nearly all are immersed. Star indistinct, often only the directive septa are recognizable. Corallum moderately

porous, surface strongly echinulate, wall finely striato-echinulate.

Diego Garcia (*G. C. Bourne, Esq.*).

Madrepora (*Isopora*) *hispida*.

Madrepora securis, Quelch (non Dana), 'Challenger' Reef-Corals, p. 148.

Corallum similar to that of *I. palifera* *, Lamk., consisting of thick plates 4 to 8 centim. broad and 2 to 3·5 centim. thick, or, in other cases, of elongate, thick, rounded branches 3 to 6 centim. diameter near the base and rarely under 3 centim. near the apex. Apices usually flattened. Corallites at the apex 2·5 to 3 millim. diameter, with smaller ones scattered amongst. Walls confluent, as in *I. palifera*. Lateral corallites usually crowded, but sometimes rather distant, short, nariform, or tubo-nariform, but the inner wall always short and thin. Diameter 1·5 millim., length 2 millim. The wall and surface of the cœnenchyma consist of radiating spinose plates, giving a very hispid appearance. Septa in two cycles, the directives broad, other primaries narrow, remainder rudimentary.

Differs from *I. palifera*, Lamk., in the smaller size of the corallites and the hispid character of the surface.

Pacific Ocean; Philippines; Banda; Ponapé.

Madrepora inermis.

Corallum consisting of slender, laxly-divided branches, which probably extend sub-horizontally. The branches are about 21 centim. long and 8 millim. thick, somewhat flattened in places, and completely or almost completely devoid of corallites on the under surface, forked and divaricately branched; the branchlets are sublateral, 1·5 to 6 centim. long, 4 to 5 millim. thick, scarcely tapering; those under 5 centim. in length are usually simple. In addition to the more noticeable branchlets there are a few short lateral sub-alternate ramiculi on the stouter branches at intervals of about 1 centim.; they are 4 to 8 millim. long and 3 millim. thick. Apical corallites 2 millim. diameter, 1 millim. exsert, wall scarcely thickened; star of six septa very well developed, with sometimes traces of a second cycle. Lateral corallites very short, spreading, tubular, rather distant; length 1 to 2 millim., diameter the same, but usually 1·5 millim., and the base may be dilated; those near the apex of a branchlet are not so spreading, but the aperture is always rounded; the longest ones are lateral in position, and on becoming prolife-

* I find that *Astræa palifera*, Lamk., is Dana's *Madrepora labrosa*, and the name has priority.

rous give rise to the short ramiculi already referred to. Immersed corallites are practically absent. Wall thin but firm, star of six septa more or less fully developed, the lower directive often much broader than the others. Corallum very dense; surface dense, smooth, and almost void of corallites on the underside, slightly rough, but not spinose on the anterior surface of the stouter branches. The wall of the apical and younger lateral corallites is roughly costulate, and the striations are continued on to the cœnenchyma, but below the striations are lost on the corallites as well as on the general surface.

South Seas.

Madrepora intermedia.

Corallum arborescent, similar to that of *M. brachiata* in habit. Main branches 2 to 2·5 centim. thick and 25 centim. long, moderately subdivided, especially near the apex; ultimate divisions 3 to 6 centim. long and 1 centim. or more thick, gradually tapering to a blunt apex or more rapidly tapering and pointed. Apical corallites 2·5 millim. diameter, 0·5 to 2 millim. exsert, but usually short; aperture large, frequently oval; primary septa well developed, secondary series not prominent. Lateral corallites tubular, spreading, very variable in length and also in diameter. The majority extend almost at right angles to the branch, excepting near the apex, and have a more or less oblique aperture; they are about 3 millim. long and 2 millim. diameter; wall firm, but not thickened. Numerous short tubular to subimmersed corallites occur between the others, varying from 1 to 1·5 millim. in diameter. The corallites become short and thickened, wart-like on the main branches, whilst on the under surface the majority are immersed. Primary septa all narrow, but the directives are the more prominent, and in the older parts of the corallum may be broad. Corallum very porous, surface reticulate and echinulate; wall striato-echinulate, becoming later echinulate in linear series.

Maldive Islands.

Madrepora leptocyathus.

Corallum flattened, vasiform from a broad base, not pedicellate. Marginal branches oblique, fused into a solid plate below, excepting near the periphery, where they are a little flattened and covered with short, crowded, appressed, tubular corallites with thin wall. On the upper surface all the branchlets rise from a solid base with very numerous immersed corallites. The branchlets are about 3 centim. long

and 1 to 1·4 centim. thick, frequently angular below, but more tapering above; the apices are usually 1·7 centim. apart. Those in the centre are chiefly simple, but may bear a few proliferous corallites; others, particularly near the margin, are divided. Apical corallites 2·5 to 3 millim. diameter, cylindrical, scarcely exsert. Lateral corallites small, crowded, tubular or tubo-labellate, spreading at right angles, wall thin and porous; they are 1·5, rarely 2, millim. diameter, and seldom over 2·5 millim. long, a little unequal, with small and delicate ones between. On the lower part of the branchlets the prominent corallites are not so numerous and the wall is thickened. Proliferous corallites 5 millim. long and 4 millim. wide (including the lateral buds). Star usually indistinct, but the directive septa are sometimes prominent. Corallum rather dense, surface finely reticulate and echinulate, wall striato-echinulate.

The type specimen appears to consist of two circular colonies fused together.

Samoa.

Madrepora macrostoma.

Corallum subcorymbose or umbellate, 33 centim. broad and 15 centim. high, consisting of crowded erect branches springing from an obconical fastigiate cluster of dead coral. Branches 4 centim. long, simple or consisting of two or three subparallel divisions about 1 centim. thick, scarcely tapering. Apices a little over 1 centim. apart. Apical corallites 2·5 to 3 millim. thick and 1 millim. exsert. Lateral corallites broad, round, and ascending, tubo-labellate above, 3 millim. long and 2 to 2·5 millim. diameter; aperture large and circular, wall very thin. Star well developed but deep, consisting of twelve prominent septa; lower down the corallites become thickened, verruciform, or immersed. Corallum very porous and reticulate in section, surface openly reticulate, wall striato-reticulate, echinulate near the base.

Mauritius.

Madrepora ornata.

Corallum stout, arborescent, branches elongate, below laxly divided, 2 to 3 centim. thick, often oval in section, divided into a cluster of branches at the apex, the whole densely covered with short ramiculi 8 to 13 millim. long and 5 to 7 millim. thick, and about 1 centim. apart, with numerous very short or immersed corallites between. Apical corallites 3 millim. diameter, 1 to 1·5 millim. exsert; wall thick, margin rounded, aperture about 1 millim. Lateral corallites short, round, nariform, with thickened wall and rounded margin,

outer wall a little convex, 1·5 to 2·5 millim. long and nearly 2 millim. diameter. On the stouter ramiculi two or three corallites become 3 millim. long and bear three or four buds. The ramiculi are as numerous on the inferior (posterior) surface of the branches as elsewhere, but are usually shorter. Star usually indistinct, but one or both directive septa moderately prominent. Corallum moderately porous, surface spongy, echinulate; wall striato-reticulate and echinulate.

The species is allied to *M. gravida*, Dana.

Darnley Island (*J. B. Jukes*).

Madrepora pacifica.

? *Madrepora robusta*, Bassett-Smith (non Dana), Ann. & Mag. Nat. Hist. vol. vi. 1890, p. 452.

Corallum subarborescent, stout, spreading obliquely, resembling that of *M. nobilis* in habit. Branchlets 6 to 15 centim. long and 2 to 3 centim. thick, simple or subsimple, tapering slightly to a blunt apex, or the distal half more rapidly tapering and pointed. Apical corallites 2·5 millim. diameter or a little over, 2 millim. exsert. Lateral corallites very much crowded, about half are elongate, tubular, half-tubular, or dimidiate, the remainder short, labellate, subimmersed, or immersed. The prominent corallites are about 1·5 millim. in diameter and 3 to 4 millim. long, spreading nearly at right angles, often a little recurved; wall firm but relatively thin, delicately striate without echinulations. Primary cycle of septa not prominent, the directives most noticeable; in many of the immersed corallites they alone can be made out. Corallum very dense, surface spongy echinulate; in many parts the corallites are so crowded that little or no cœnenchyma occurs between them.

A specimen referred by Bassett-Smith to *M. robusta* appears to belong to this species, but the branches are not so stout as in the type, and the corallum appears to form an incrustation over dead pieces of coral.

Pacific Ocean; Samoa Islands; China Sea.

Madrepora (Isopora) plicata.

Corallum consisting of broad oblique plates from a common base. The plates are about 8 centim. long and 4 to 9 centim. broad near the apex, narrower below and 1 centim. thick. Each plate bears one or more prominent longitudinal ridges on its surface. Each ridge bears a number of rosettes of corallites, the centre corallite in each being rather larger than the others, thus indicating an approach to branch formation with its accompanying enlarged terminal (parent) corallite. Corallites at the apices of the plates tubular, 2 millim. in

diameter, slightly prominent, wall thick and porous. Lateral corallites tubular and appressed above, shorter and more spreading near the base. Length 1 to 4 millim., diameter 1 to 1·5 millim. Aperture large; wall thin compared with other species of the subgenus. Surface finely clothed with longitudinal series of dentate plates.

The species differs from all others of the subgenus in the possession of thin-walled lateral corallites.

Tongatabu (*J. J. Lister, Esq.*).

Madrepora polymorpha.

Madrepora abrotanoides, Dana (non Lamarck), Zoophytes, p. 477, pl. xli. fig. 1; Verrill, Bull. Mus. Comp. Zool. vol. i. 1864, p. 41; Rathbun, Proc. U.S. Nat. Mus. vol. x. 1887, p. 12.

Corallum fruticose, spreading, ramose; branches 8 to 20 centim. long, usually about 1·5 to 2 centim. thick, gradually tapering; the branches bear numerous branchlets, spreading usually at an angle of 80° to 90°, and varying in importance from thickened and elongate proliferous corallites to subterete and tapering twigs 4 centim. long and 1 centim. thick. Apical corallites 1·5 to 2 millim. diameter and 0·5 to 2 millim. exsert; wall thick or comparatively thin. Lateral corallites compressed, nariform, or tubo-nariform, unequal, the longer ones becoming tubular and proliferous; some distance below the apex all become verruciform, with a dilated wall, which gradually becomes reduced to a ring-shaped fold. Immersed corallites are usually wanting, even in the older parts of a colony; but in one or two specimens which agree closely in other respects immersed corallites may take the place of those with a ring-shaped lip. Lateral corallites 1·5 millim. diameter or under and 1·5 to 3 millim. or more in length; aperture oval, wall varying in thickness in different specimens; always thickened some distance below the apex of a branch, and in some cases quite to the apex; in the latter case the wall of the apical corallite is also thickened. The apical corallites are provided with twelve septa, none of which are very prominent; those of the lateral corallites are also usually narrow, including the directives; in the corallites situated some distance from the apex the second cycle is almost as well developed as the first. Corallum dense, even near the apex of a branch in most specimens; surface and wall finely and closely echinulate.

Indo-Pacific Ocean; Malacca; Fiji?

Madrepora polystoma.

Corallum corymbose and complanate below, 35 centim. wide and 12 centim. high, closely resembling that of *M. con-*

cinna in habit. Branches complanate below, the basal parts fused into a solid plate with immersed corallites; distal parts with hemicotyloid corallites and a few lateral, tubular or conical ones. Branches on the upper surface about 4 centim. long and 1·3 to 1·5 centim. thick, angular below, with crowded immersed corallites; often divided above into two to four branchlets, many of which, especially near the centre of the corallum, bear numerous ascending proliferations. Apical corallites 2·5 to 3 millim. diameter, rarely over 1 millim. exsert, margin scarcely rounded. The central branchlets bear crowded proliferations, 7 millim. long and 4 millim. thick, with crowded immersed corallites between; others are dimidiate and appressed, 2·5 to 4 millim. long and 1·5 millim. thick; wall thin but firm. The peripheral branchlets have few proliferous corallites; most are subequal, nariform, with an elongate lip, and a little compressed, 3 millim. long and 1·3 millim. thick. Star moderately prominent, the directive septa very broad. Corallum rather porous, surface finely echinulate, wall striato-echinulate.

Mauritius.

Madrepora procumbens.

Corallum prostrate or subprostrate, subdivisions free. Branches up to 16 centim. long and 1 centim. thick, bearing ramiculi 1·3 to 3·5 centim. long, each of which is usually produced from a single tubular corallite by the formation of lateral corallites upon it, nariform or tubo-nariform at first, but becoming spreading tubular, 4 to 9 millim. long. There may be twenty or more on a twig 3 centim. long, radiating in all directions, the longer ones arched and bearing very short nariform buds. The stem and main branches bear a few corallites at irregular intervals, nariform or subimmersed and immersed. The elongate tubular corallites are 2 millim. diameter near the base and 1·5 at the apex. Apex suddenly contracted; aperture small, enclosing a star of six well-developed septa. Corallum dense, surface finely echinulate, not pitted, wall echinulate in rows.

This species comes near to *M. longicyathus*, and may prove to be only a well-marked variety of it. It differs, however, in habit and in the arrangement and number of the corallites on the branchlets; the axial corallite also usually bears buds to within 2 millim. of the apex, whereas in *M. longicyathus* the terminal 7 millim. is usually free. In one specimen the branches extend horizontally, in another obliquely.

South Seas.

Madrepora pulchra.

Madrepora cribripora, Bassett-Smith (non Dana), Ann. & Mag. Nat. Hist. vol. vi. 1890, p. 452.

Corallum arborescent, branches 1·2 to 1·8 centim. thick, terete, bearing branchlets or radiating clusters of branchlets at intervals of 2·5 to 5 centim.; branchlets elongate, simple or subsimple, 3·5 to 9 centim. long, 8 to 12 millim. thick, gradually attenuate; the angle of the branchlets varies from 30° to 90°. Apical corallites 3 millim. diameter, about 2·5 millim. exsert; those of the branchlets rather smaller. Lateral corallites all spreading at right angles, excepting near the apex of a branchlet, all short, tubular, a little variable in length, and exhibiting considerable variation in diameter. Length subimmersed to 1·5 millim., diameter 0·75 to 2 millim. The aperture of the larger corallites is usually a little oblique, and in some cases the inner part of the wall is only slightly developed, whilst the outer is elongate, giving a tubo-labellate form; the inner part of the wall is, however, rarely absent, excepting in the older parts of the corallum, where the majority of the corallites are immersed. The outer part of the wall is usually a little thickened in the larger corallites, but the aperture remains over 1 millim. in diameter. Star of the apical corallites consisting of six well-developed subequal septa, the second cycle rudimentary; in the lateral corallites the star is rudimentary, the directives usually recognizable, and sometimes two or, more rarely, four others. Corallum very porous, surface reticulate and echinulate; wall striato-reticulate, echinulate in the case of the stouter corallites.

Keeling Island; Tizard Bank.

Madrepora samoensis.

Corallum cespitose from a broad, rounded, incrusting base; height of corallum 24 centim., breadth 28 centim. Branches very stout and much divided. The main branches usually become divided into eight or ten secondary ascending branches, which increase in length towards the centre of the corallum; the outer ones are 3 to 5 centim. long, the inner ones 12 or 13 centim.; these branches are often 2 centim. thick, not terete, but, owing to crowding, they are more or less angular in section; the secondary branches bear a third series of ascending branchlets 2 to 6 centim. long and 1 centim. thick, those directed outwards being longest and most numerous. All the divisions are only slightly tapering and have a blunt apex. Apical corallites 3 millim. diameter or less in the case of the smaller subdivisions, scarcely exsert; wall thick, very porous, margin rounded. Star very distinct, the

primary septa often nearly meet in the middle line, but in the smaller corallites the directives are broadest; a second cycle is also moderately developed. Around the apical corallite the lateral corallites are frequently arranged in subregular longitudinal rows. The lateral corallites are nariform or short-tubular at first, with the inner part of the wall more or less incomplete, the outer part thickened and very porous; they are 2 to 3 millim. long and about 2 millim. diameter. Rows of smaller subimmersed corallites are situated between the prominent ones, but the linear arrangement is lost 3 to 5 centim. from the apex. At a point about 2 centim. from the apex the prominent corallites become more thickened and bear buds; they are then about 4 millim. long and nearly 3 millim. diameter. Such proliferous corallites occur at intervals of 5 to 8 millim. over the whole of the upper part of the corallum; a few become more elongate and may attain a length of 2 centim. At a point varying from 2·5 to 6 centim. from the apex of a branch or branchlet the whole of the corallites become short, and on the inner sides of the branches almost all of them are immersed. The star of the lateral corallites not destined to form proliferations is quite indistinct, usually only the directive septa are recognizable. Corallum very porous; surface spongy reticulate and echinulate, becoming regularly reticulate below; wall striate and fenestrated, margin not rounded.

Samoa Islands (*Rev. S. J. Whitmee*).

Madrepora spathulata.

Corallum prostrate, complanate below. Branches 1·5 centim. thick, flattened on the under surface, with numerous immersed and short nariform corallites, and a few spreading tubular ones between; branchlets in the general plane with one or several tubular corallites near the apex, often 5 millim. long and 2 millim. thick. Branches on the upper surface arcuate, 7 centim. long, and usually consisting of two branches fused together, so as to be somewhat oval in section, 1·8 by 1 centim., usually 1 centim. thick up to within 1 centim. of the apex; divided nearer the apex into two to four branchlets, most of which are also imperfectly divided into two; apices blunt. Apical corallites 2 to 2·5 millim. thick, scarcely exsert; wall thick and very porous; aperture usually small, but sometimes funnel-shaped. Lateral corallites crowded, spreading at right angles, 2 millim. broad and long in the upper parts, spathulate, and the rounded lip sometimes recurved; below the wall is not so prominent and a little thickened, and at the base of the branchlets the corallites are all subimmersed or immersed; aperture nearly 1 millim., but

the cells occurring in lines of fusion are smaller. Star indistinct, only the directive septa recognizable. Corallum very porous, surface reticulate and echinulate; wall fragile, striato-reticulate, and later echinulate.

Treasury Island, Solomon Islands (*Dr. Guppy*).

Madrepora subglabra.

? *Madrepora echinata*, Quelch (non Dana), 'Challenger' Reef-Corals, p. 162.

Corallum extending in elongate, slender, and oblique or subprostrate branches, closely resembling *M. procumbens* in habit and in the form of the branchlets. Branches 6 to 18 centim. long, 7 millim. diameter, not terete, owing to the swollen bases of the branchlets. Branchlets 1 to 4 centim. long, similar to those of *M. procumbens*, but the corallites are more slender, scarcely over 1 millim. diameter at the apex; margin plane, aperture not contracted; they vary from 4 to 15 millim. in length, the majority are about 7 millim. long, the terminal 3 or 4 millim. being free from budding corallites. The main branches bear a very small number of subimmersed corallites about 0·7 millim. diameter. The star consists of six septa, the directives being thick and prominent, the others much narrower. Corallum dense, surface almost smooth, excepting near the apex, where it is finely echinulate; wall very finely striato-echinulate at first, the striæ becoming lost later, and subsequently the echinulations as well.

The 'Challenger' specimens referred by Quelch to *M. echinata*, together with another specimen in the collection, appear to differ from the above in having a slightly more prostrate habit and in the presence of stronger echinulations; but in these the echinulations are much finer and shorter on the inferior surface of the branches.

South Seas; Fiji Reefs.

Madrepora symmetrica.

Corallum broad, flat, corymbose, with a short central base, scarcely pedicellate, 35 to 52 centim. broad and 12 to 14 centim. high. Under surface complanate, branches crowded and coalescent, somewhat flattened below; branches 1 centim. thick, with numerous much appressed corallites and lateral tubular ones, which give rise to branchlets in the general plane; some are 8 to 10 millim. long, 2 millim. thick, and simple; others bear lateral nariform corallites, others again tubular ones, those near the base being elongate and very spreading; immersed corallites almost absent from the under surface. On the upper surface the main branches give rise

at intervals to clusters of two to five suberect branchlets, and their distal extremities are arcuate, 3 to 3·5 centim. long, and divided into branchlets, which, like the more central ones, are 2 to 3 centim. long and scarcely 5 millim. thick; apices 6 to 7 millim. apart. Upper surface of the main branches and base of the branchlets provided with numerous large immersed corallites, with an aperture of 1 millim. Apical corallites about 2 millim. diameter, usually about 1 millim. exsert. Lateral corallites ascending, elongate, labellate, and imbricate, 3 to 4 millim. long and 1·5 millim. thick, apices more or less pointed. Corallum very porous and reticulate in section, surface densely echinulate; wall thin, finely striato-reticulate and echinulate, except in the case of the younger ones. Star not recognizable in the prominent corallites; in the immersed ones it consists of six very narrow septa.

Two specimens have the apices of some of the branchlets subdivided; in a third the majority are proliferous and some of the apical corallites rather over 2 millim. in diameter.

Mauritius.

LV.—*Contributions towards a General History of the Marine Polyzoa*, 1880–91.—*Appendix*. By the Rev. THOMAS HINCKS, B.A., F.R.S.

[Continued from p. 176.]

'Annals,' July 1881 (p. 55 sep.).

Hiantopora ferox, MacGillivray.

In a previous paragraph I have pointed out that this form cannot be referred to *Cribrilina*, from which genus it has been rightly separated by MacGillivray. Since it was written I have seen Mr. Kirkpatrick's Report on the Polyzoa from Torres Straits collected by Professor Haddon *, in which he ranks *Hiantopora ferox* as a variety of *Membranipora radicifera*, Hincks. The connexion between these two very dissimilar species he supposes to be established by the discovery of a variety of *M. radicifera*, to which he has given the name *intermedia*. Granting that the latter is, as Mr. Kirkpatrick supposes, a variety of *M. radicifera*, the further development and fusion of its spinous processes may have originated a form bearing a general resemblance to *H. ferox*. Beyond this, I confess, I am not prepared to go. Mr. Kirkpatrick goes much further; he assumes that

* 'Scientific Proceedings of the Royal Dublin Society,' vol. vi. part 10.

Hiantopora ferox is the product of such a process *; and though in the course of its development it has emerged from the Membraniporine ranks and taken a higher morphological place, he proposes to leave it at the point from which it started, and to unite under one specific name forms which in fact are widely separated by essential differences.

It must be borne in mind that we cannot say with absolute certainty that *H. ferox* has been developed from the particular species *Membranipora radicifera* and in the special way indicated; this is merely conjectural. But if we could, the evolution has resulted in a distinctive and higher grade of organization, a new type of structure, which it is the function of a rational classification to recognize and to mark.

The differences between *Hiantopora* and *Membranipora* are striking and significant. The membranous front wall of the latter, wholly unprotected, or in some cases partially protected by a thin lamina, in others by marginal spines, is arched over in the former by a strong calcareous covering, allowing of various important structural modifications and affecting materially the conditions of life. Granting that the evolution of *Hiantopora* has proceeded as Mr. Kirkpatrick supposes, it is now far from being a mere "variety" of *Membranipora radicifera*; it is this *plus* the morphological changes which have been gradually effected according to evolutional laws. It has lost the characteristic features of the Membraniporine structure, and in any system which aims at exhibiting the natural scheme of life-development it must be placed apart to represent the morphological advance and stand as an evolutional landmark.

Ibid. (p. 56 sep.).

Cribrilina speciosa, sp. n.

Busk identifies this species (doubtfully) with his *C. philomela* ('Challenger' Report, p. 132, pl. xvii. fig. 6); but there can be little doubt that the two forms are distinct. They differ in the shape of the cell and of the orifice, which is suborbicular in *C. speciosa*. In the latter the costate area does not occupy the whole of the front, as in *C. philomela*, but is surrounded by a smooth border of cell-wall; the intercostal furrows are destitute of pores, and the area is traversed by a prominent central keel. There are also differences between the oœcia of the two forms.

* "In the latter (*H. ferox*) the spines have undergone further development; the horizontal portion on the avicularian side of the cells has grown over the whole area, and fused with the opposite cell-margin" (*loc. cit.* p. 616).

Busk also describes under his *C. philomela* a variety (*adnata*) *, leaving it doubtful whether it is referable to this species, or to *C. figularis*. It is certainly allied to the latter, but is distinct from it. It has no claim to be associated with *C. philomela*, but should rank as a separate species.

Ibid. (p. 57 sep.).

Cribrilina monoceros, MacGillivray.

This species is certainly not a *Cribrilina*, as Jullien has already remarked; it wants the Cribriline structure of the front wall. He refers it to a new genus (*Arachnopusia*), which he makes the type of a family group †.

The following is his diagnosis:—

Family **Arachnopusidæ**, Jullien.

"Orifice trapézoïdal; frontale perforée par des pores disposés irrégulièrement, aux lieu et place desquels on ne peut distinguer d'origelles sur les exemplaires décalcifiés et teints au picro-carminate d'ammoniaque; opercule pellucide, très mince, très difficile à voir, d'une existence douteuse. Ancestrule membraniporoïde épineuse."

Genus Arachnopusia, Jullien.

"Orifice trapézoïdal, dont les deux lèvres sont droites ou presque droites; sur chacun des côtés du trapize que forme l'orifice existe soit une épine articulée, assez épaisse et creuse, soit un avicellaire plus ou moins facile à voir; ancestrule membraniporoïde à bord libre garni d'épines.

"Par l'ancestrule ce genre se rapproche des *Mucronella* de Th. Hincks."

Upon this I may remark that the characters adduced as the basis of the family are clearly insufficient and wanting in significance. The orifice is by no means "trapezoidal" as a rule; it is usually arched above and straight or nearly so below. The absence of "origelles" in connexion with the pores, which are thickly distributed over the front wall, the tenuity and transparency of the operculum, and the structure of the primary cell ("ancestrule") are the only remaining characters. The last-named is not distinctive, but is common to many widely differing genera (*Microporella*, *Schizoporella*, *Mucronella*, &c.). We know too little as yet of the nature

* 'Challenger' Report, pl. xxii. fig. 7.

† 'Cap Horn,' p. 62, pl. iii. figs. 8, 9.

and function of the *origellæ* * to assign to them the high systematic value which is here claimed for them. The tenuity of the operculum is shared by many other forms, and is not in itself of any special importance.

Apart from these family characters, in which of course it participates, the genus *Arachnopusia* rests on a single peculiarity, the presence of a tall articulated spine (sometimes replaced by an avicularium) on each side of the orifice, a character of merely specific value.

I should be inclined to place *Lepralia monoceros*, Busk, *in the same group as Hiantopora ferox* (see note 2, p. 472).

Additional Localities. Elizabeth Island, Straits of Magellan, 6 fath.; Tom Bay, near Madre de Dios Archipelago (teste *Stuart O. Ridley*): Port Jackson, 35 fath.; off Marion Island; Tierra del Fuego; coasts of Patagonia; Cape Horn; north of Van Diemen's Land; Crozet Islands; Pacific Ocean, 3125 fath. (*Busk*).

Ibid. (p. 58 sep.).

Microporella mucronata, MacGillivray.

This species proves to be identical with the *Eschara coscinophora* of Reuss (Wien. Tertiär. 67), and his name must therefore supersede MacGillivray's. In conformity with views which I have stated elsewhere †, I should refer this and kindred forms to the genus *Adeona*, Lamx., and to the subsection of it which includes species destitute of the flexible stem.

Ibid. (p. 58 sep.).

MONOPORELLA, gen. nov.

The name *Haploporella* having been previously employed, the above has been substituted for it ('Annals,' ser. 5, vol. viii. p. 135, note 2) (p. 78 sep.).

Ibid. (p. 59 sep.).

Monoporella lepida, sp. n.

Waters in the first instance identified this species with *Membranipora perforata*, MacG., but subsequently admitted

* "Des bourgeons charnus développés sur l'endocyste; elles sécrètent du calcaire sur leur pourtour seulement, en produisant des pores plus ou moins réguliers sur le bord des zoœcies" (Jullien, Bull. Soc. Zool. de France, t. xi., 1886).

† See "Critical Notes on the Polyzoa," Ann. & Mag. Nat. Hist. ser. 5, vol. xix. p. 150.

its specific distinctness, and placed it in the genus *Micropora* *. It may be well to note some of the principal differences between the two forms:—i. There are important differences in the orifice; that of *M. perforata* is very inferior in size, arched above and perfectly straight below, and very narrow between the upper and lower margins; it is also much raised above the front wall. That of *M. lepida* is more than twice as large; the angles at the junction of the sides with the inferior margin, so marked in the other form, have disappeared, and the orifice is almost subelliptical.

ii. In MacGillivray's species the cell tapers off abruptly to the top, which is much narrower and more pointed than in *M. lepida*, and the raised margin is only carried to *the base of the orifice*, which stands out prominently at the apex of the cell, whilst in *M. lepida* it is carried to the top of the orifice and encloses it. Indeed there is a striking contrast between the zoœcia of the two species in size, form, and general character.

iii. In *M. perforata* the avicularia are small and placed at the top of the cells immediately above the orifice on a slight elevation, and are furnished with a triangular mandible. In *M. lepida* they are scattered amongst the zoœcia and occupy a distinct area of considerable size; they are comparatively large; the beak is broad below, where there are two strong denticular processes on which the mandible works, and tapers upward, curving slightly to one side; the mandible I have not seen, but there can be little doubt that it is elongate, tapering, and pointed.

iv. It may be added that in *M. perforata* there is a stout spine on the side of the orifice above, which is wanting in *M. lepida*, and that the ovicells, judging from MacGillivray's figure, differ in shape. That of the last-named species is small and globose.

Not only are these forms undoubtedly distinct specifically, but I am by no means satisfied that they belong to the same genus. *Membranipora perforata*, MacG., is a characteristic *Micropora*; but *Monoporella lepida* has several features which serve to indicate its affinity with the Microporellidæ. The termination of the cell-margin at the base of the orifice, leaving it free and truly "apical" †, is, so far as I know, a

* "Bryozoa from Bairnsdale," Quart. Journ. Geol. Soc., Nov. 1882. Referring to the two forms he says, "I think they must not only be united generically, but can only rank as specific varieties." See also "Tertiary Chilostomatous Bryozoa from New Zealand," Quart. Journ. Geol. Soc., Feb. 1887.

† See Busk's diagnosis of the genus *Micropora*, 'Challenger' Report, p. 70.

characteristic feature of the genus *Micropora*; the depressed lamina, overspread by a membranous covering (at least in the living state), and the suboral foramina or fissures are also characteristic features; and they seem to be all of them wanting in *M. lepida*. In the latter the cell-margin extends to the top of the orifice and closes it in; the front wall is convex, though only slightly; there is no trace of an outer membranous wall, while the lateral perforations or pores cannot be placed in the same category with the suboral "opening" or fissure amongst the Microporidæ. They are evidently of exactly the same character as the punctures, which are so commonly present along the margin of the cell. Commonly there are three on each side in *M. lepida*, of which the uppermost is frequently the largest, but by no means universally. Sometimes those on one side are of much the same size, sometimes the uppermost is smaller than the rest. They are circular or subcircular in form. The Microporidan suboral foramen is usually close under the lower margin of the orifice on each side, and so it is in the only specimen of *M. perforata* which I have had the opportunity of examining. On the whole I am inclined to think at present that *M. lepida* should rank amongst the Microporellidæ; but without the opportunity of studying a larger range of specimens it would be unwise to come to an absolute decision.

Ibid. (p. 60 sep.).

Porina (*Eschara*) *gracilis*, Lamx.

Lamouroux's specific name has been set aside by Waters in favour of *coronata*, Reuss (Wien. Tert. 62). There seems to be no sufficient ground for the change, which in itself is undesirable. Lamouroux's diagnosis may be imperfect, but Lamarck, Milne-Edwards, Busk (B. M. Cat. and Chall. Rep.), MacGillivray (Vict. Pol.), and others have identified his species and adopted his name. A designation so generally adopted, and by such eminent authorities, should not be lightly displaced. Waters himself has suggested * that Milne-Edwards, who has given a fuller description than Lamouroux, should be joined with him, as authority for the name. Such a course (if needful) would certainly be preferable to its suppression.

Ibid. (p. 60 sep.).

Schizoporella triangula, sp. n.

Busk, in his description of this species ('Challenger'

* "Australian Bryozoa," 'Annals' for September 1887, p. 189.

Report, p. 167), mentions a small avicularium, with an acute triangular mandible close to the orifice, which is not included in my diagnosis.

Additional Locality. "Off Heard Island, 70 fath., volcanic mud."

Ibid. (p. 64 sep.).

Schizoporella tumida, sp. n.

This species is one of a group of allied forms which are all distinguished by the possession of an aviculiferous suboral swelling, differing in size and shape, but the same in general character. They are *S. Ridleyi*, MacG., *Escharina simplex*, D'Orb., *Esch. Edwardsiana*, D'Orb., and the present species. I was at first inclined to identify *S. Ridleyi* with *Escharina simplex*, D'Orb.; but Mr. Quelch, who had the opportunity of examining the type specimens of the former, has arrived at a different conclusion, and as my knowledge of them is derived entirely from figures and descriptions, I readily accept his decision. They are clearly very nearly related. *S. tumida* has much in common with D'Orbigny's species, but there is a marked difference in the form of the mouth and the character of the suboral swelling, which is of ampler size and more regular shape, forming a thick rounded collar round the front and sides of the orifice. This species is also furnished with another form of avicularium (in addition to the suboral form) borne on a large ovate rising on the surface of the cell which lies alongside the orifice and extends for some distance downwards.

It is also remarkable for its perfectly smooth surface.

Escharina Edwardsiana, D'Orb., is another species with the same general character of orifice and suboral region, but exhibiting some minor differences.

These species represent to all appearance slight modifications of one and the same type.

Ibid. (p. 62 sep.).

Schizoporella acuminata, sp. n.

The acuminate extension of the cell above in this species appears not to be so permanent a character as I had supposed. Mr. Waters has obtained *S. acuminata* from the Australian Tertiaries, and finds that this is not a constant character in fossil specimens. "Some cells," he says, "are acuminate, while others are round, and I have specimens from Bairns-

dale (Gippsland) in which none of the cells are acuminate." (Quart Journ. Geol. Soc., Aug. 1882.)

'Annals,' August 1881 (p. 65 sep.).

Mucronella porosa, sp. n.

This species must, I think, be considered a form of MacGillivray's *M. Ellerii*, as Mr. Waters has suggested *, though there are striking differences between them. The most remarkable feature of *M. Ellerii* is the line of spinous processes with rounded heads situated on the peristome, which is much elevated. These are entirely absent in *M. porosa*, and the peristome is not raised; consequently the general aspect of the zoarium in the two forms is strangely dissimilar. As a result probably of the elevated spinous peristome in *M. Ellerii* the massive central mucro is not developed, and the large avicularium occupies a place some way down within the lower margin. The surface of the cell is more or less covered with nodules distributed amongst the pores.

M. porosa is much simpler in character. There is a total absence of the spinous processes; the centre of the lower margin bears a massive mucro, much swollen at the base, on one side of which, turned slightly inward, is placed the avicularium, with a broad rounded mandible. Large spatulate scattered avicularia are present at times on both forms. In a specimen from Singapore or the Philippines numerous smaller avicularia, elevated above the surface and resembling the oral form, are distributed over the cells.

The cells in *M. Ellerii* are suberect. The small rounded avicularium on the margin at one side of the mucro is characteristic of *M. porosa*. The latter may stand as *M. Ellerii*, form *porosa*.

M. vultur †, which Mr. Waters would also refer to *M. Ellerii*, is, I think, entitled to specific rank. Its remarkably large cells, decumbent, not suberect or oblique like those of *M. Ellerii*, its exceptionally massive mucro, its large avicularium, with its elongate, finely pointed mandible bent abruptly inward at the top, its large, articulated, oral spines, form a group of distinctive characters. The cells of *M. vultur* differ not only in size but in general character from those of *M. Ellerii* and its form *porosa*.

* "Australian Bryozoa," 'Annals' for September 1887, p. 194.

† "Contributions" &c., p. 98 (sep.).

Note on Hiantopora ferox, MacG., *and* Cribrilina monoceros, *Busk.*

In the earlier portion of this paper I have referred to Mr. Kirkpatrick's remarks on the systematic position of the former of the above species, and have suggested that there is probably a close affinity between it and *Cribrilina monoceros*. A careful examination and comparison of the two forms has convinced me that they are very nearly related and should probably find a place in the same genus. Reverting for a moment to Mr. Kirkpatrick's paper, I venture to suggest that the form which he describes as a variety (*intermedia*) of *Membranipora radicifera* may prove to be only *an early stage in the development* of *Hiantopora ferox*. His figure certainly bears a very close resemblance to cells of the latter species on the growing edge of the colony which have lately come under my notice. The zooecium represented in his figure is in an early stage of growth; the lower margin of the orifice is incomplete, but from the base of the avicularian cell (or from the margin beneath it) processes are budding which, in conjunction probably with offshoots from the side-wall of the cell, have already all but formed one or two of the large pores which are so striking a feature of the species. A marginal cell in a fine colony of *H. ferox* (which Miss Jelly has kindly lent me for examination) is in a similar stage of development, and presents very much the same appearance. Other cells exhibiting various phases of growth enable us to trace the history of the mature form.

As to the relationship between this species and *C. monoceros* there can, I think, be little difference of opinion. The development of the zoœcium is essentially the same in both. In its earliest stages the cell is simply Membraniporine in character; the first change is the completion of the calcareous framework of the orifice, which is effected by the formation of a bar across the aperture, which shuts off the upper portion of it and constitutes the inferior margin of the oral opening. By the successive growth of a number of calcareous processes from the lower margin of the orifice and the side-walls of the cell, the extremities of which meet and are fused together, a perforated shield is formed which arches over and protects the membranous front wall. As I have said, the method of construction is similar in both forms, and the structural elements are alike. They may certainly rank in the same genus, and probably in MacGillivray's *Hiantopora*.

The affinity between these forms and the Cribrilinidæ is sufficiently apparent, but they can hardly be included in the

same family. The elements of the protective covering in the latter are modified marginal spines; in the former they are special processes given off from the walls of the cell. These are not morphological equivalents, whilst the general character of the two structures is dissimilar. *Hiantopora* must therefore be the type of a distinct family group.

[To be continued.]

MISCELLANEOUS.

On the Nervous System of Monocotylidæ. By M. G. Saint-Remy.

Among the *Tristomeæ*, the nervous system of the *Tristomidæ* is well-known, thanks to recent researches, in particular the labours of Lang and Monticelli. No precise observations have hitherto been made on the *Monocotylidæ*, of which we have examined two types—*Pseudocotyle squatinæ* and *Microbothrium apiculatum* *.

We know that, among the *Tristomidæ*, the brain, situated above and in front of the pharynx, sends out six pairs of nerves, three in front and three behind (lateral nerves), of which the two outermost, ventral in position, extend as far as the posterior sucker, where they anastomose. The nervous system of *Pseudocotyle squatinæ* most nearly resembles this type. The brain is a thick band, incurved during growth, and situated in front of the pharynx, above the vestibule; it gives rise to five pairs of anterior nerves, and behind to two or perhaps three pairs of lateral nerves. The first pair of anterior nerves is large, arises directly against the median line in the upper region of the brain, and loses itself in the parenchyma, above the mouth: it is the homologue of the nerves of the Tristomian frontal lobe, the internal nerves of Monticelli. The second pair is very slender and of little importance; the third is constituted by two branches which start one from each exterior angle of the brain, and lose themselves outside: they represent the nerves of the suckers (median nerves) of the *Tristomidæ*. The fourth corresponds to the third pair of the latter: it is formed of two strong branches, which pass forwards and inwards to unite in the median line, as in *Tristomum*, but remain here without contact with the other anterior nerves. Lastly, the fifth pair is represented by two little accessory threads of no importance.

As regards lateral nerves, we have found two pairs of strongly

* These investigations were made upon animals collected at the Roscoff laboratory, where Prof. Lacaze-Duthiers was good enough to accord to us the most liberal hospitality.

developed ventral branches, corresponding to those of the *Tristomidæ*, and it appeared to us that there was a descending branch running along the pharynx, and appearing to unite with its homologue on the opposite side: this nerve would perhaps represent the latero-dorsal nerve of the *Tristomidæ*.

The two internal and external ventral nerves of each side (the internal one being stronger and following the contour of the reproductive organs, the external more slender and more incurved) start from the infero-posterior extremity of the brain and unite in the posterior region of the body, a little in advance of the sucker, forming a little ganglion on each side, which gives off a nervous branch. We did not determine the presence of commissures between the right and left nerves, but those of the same side are united by three transverse branches, and the internal nerve sends off a few rami which pass to the neighbouring organs.

The nervous system of *Microbothrium apiculatum* is the most complicated yet observed in the group. Besides the brain, there exist two post-pharyngeal centres united by a transverse commissure, and a large ganglion in the posterior region of the body. The brain, which is much reduced in size, gives off anteriorly only two branches, which correspond to the first pair of nerves in the *Tristomidæ*. Posteriorly, it is prolonged on each side of the pharynx into a branch passing to the pharyngeal ganglion, and giving off two little threads, which are perhaps homologous to the second and third pairs of *Pseudocotyle*. The pharyngeal ganglia are two large nervous masses united by a transverse branch; from the latter there arises a pair of very short nerves, corresponding to the latero-dorsal nerves of the *Tristomidæ*; from each ganglion there are given off two longitudinal nerves (internal and external ventral nerves) and two accessory ones which lose themselves in the parenchyma; lastly, from the extremity of the ganglion there arises an anterior nerve, which seems to prolong the external ventral nerve, and extends as far as the mouth, uniting in its course with the branch passing from the brain to the pharyngeal ganglion: this nerve appears to represent the third anterior pair of the *Tristomidæ*. The two ventral nerves are united to one another by three commissures as in *Pseudocotyle*. Posteriorly they enter a ganglion whence four pairs of nerves are given off, of which three are posterior and one tolerably long anterior; this important nervous apparatus corresponds to the power of the muscular system in this region.

These researches show, on the whole, that the nervous system of the *Monocotylidæ* is constructed on the same plan as that of the *Tristomidæ*, but exhibits a somewhat greater degree of complication, which we should not have expected.—*Comptes Rendus*, tome cxiii. no. 4 (July 27, 1891), pp. 225–227.

On the Structure of the Ocelli of Lithobius. By M. Victor Willem.

The study of the ocelli of *Lithobius forficatus* has been the object of researches by Graber and Grenacher; but the descriptions given by these two authors differ in all their details, so much so that they seem, as Grenacher himself remarks, to have examined different animals.

Graber * states in effect that the visual organs of the Myriapods have an organization so similar to that of the eyes of Arachnids that he deems it useless to give a special description of them. Now, according to this author, the ocellum of an Arachnid comprises two layers of cellular elements, separated by a delicate lamellar membrane:—a *complete* layer of cells clothing the internal face of the corneal lens and representing a vitreous body, and, in the second place, a retina formed of elements *directed parallel to the axis of the eye.* Each of these retinal elements must be considered as constituted by a basal ganglion-cell, the terminal prolongation of which, or rod, is *capped by a uni- or sometimes binuclear cell.*

According to Grenacher † there is found beneath the cornea a circlet of large pigmented prismatic cells, forming around the axis of the eye a hollow cylinder, the cavity of which is occupied by *transversely directed* cilia converging from the internal margin of the cells (*Haarzellen*) towards the axis of the visual organ. The posterior part of the ocellum is occupied by a hemispherical group of *unicellular* pigmented retinal elements, each one of which is terminated on the inner side by a rod, the structure of which is extraordinarily difficult to elucidate. Lastly, behind the lens we may observe a *limited* number of little cellular nuclei.

A third observer, Sograff ‡, gives a vague and very summary description of *Lithobius,* which does not accord with either of the foregoing.

In spite of the numerous difficulties which this study presents, I have succeeded in obtaining satisfactory sections of this organ, and have found that their structure corresponds, at any rate broadly, with the description given by Grenacher.

Each of the ocelli has the form of an elongated cylinder, bounded externally by the cornea, and surrounded by a connective membrane which is traversed by the optic nerve; in the furrows which separate the corneal facets from one another this membrane is thickened and encloses a number of little pigment-cells.

* "Ueber das unicorneale Tracheaten- und speciell das Arachnoïden- und Myriopoden-Auge," Archiv für mikroskopische Anatomie, 17ter Band, 1880.

† "Ueber die Augen einiger Myriopoden," *ibid.* 18ter Band, 1880.

‡ 'Anatomie de *Lithobius forficatus,*' Moscow, 1880, p. 26 (in Russian).

The cavity of the ocellus is occupied by cells belonging to two different types, besides a few little cellular elements applied against the cornea, even in the centre of its inner face.

The first, the *Haarzellen* of Grenacher, which are elongated and of relatively little thickness and pigmented, form, by attaching themselves by their large faces, a hollow cylinder, which separates the cornea from the true retina. They terminate on the inner side in delicate cilia, which, in my sections, do not appear with the regularity which Grenacher's figures ascribe to them, but are found adhering together in irregular pencils. May these ciliated elements be "giant" recipient cells similar to those which Patten has described in the larva of *Acilius*, and of which the altered rods would no longer be represented, in the preparations of Grenacher and myself, except by fibrillæ running at right angles to the direction of the retinidium? I cannot admit this explanation, for the way in which these ciliated cells and the true retinal cells respectively behave towards fixing reagents forces me to conclude that these two kinds of elements have not the same morphological significance.

The bottom of the optic cup is occupied by some twenty retinal cells, which Grenacher says he has been unable to observe in their entirety except in exceptional cases. Each of these cells presents a basal portion enclosing the nucleus, some pigment-granules, and, in connexion with a nerve-fibre and a terminal segment, Grenacher's rod, which is clearly transversely striated. In certain favourable sections I have determined the presence, between the striated segments of the adjoining cells, of elongated elements, presenting the same appearance as the lateral rods of the retinal cells of the larvæ of *Acilius*. Sometimes, in transverse sections, I have observed in the centre of the meshes of the plexus formed by the section of the external segments, a corpuscle of special refractile power, which I could only regard as the section of the axial nerve-fibre of each cell. Do the transverse striations of the terminal segment correspond to the fibrillæ of a retinidium, similar to that which Patten describes generally in the terminal segments of the retinophores? This is a problem which the extreme minuteness of the elements observed does not permit me to solve.

The pigment-granules of the ciliated and rod-cells occupy a more or less extended zone, according as the ocelli have been fixed in sunlight or in shade.

I would observe in conclusion that the appearance of certain of my preparations resembling Graber's figure explains to me the error of interpretation perpetrated by this observer, due to a rapid examination, with a preconceived idea, of sections which were not sufficiently thin.—*Comptes Rendus,* tome cxiii. no. 1 (6 juillet, 1891), pp. 43–45.

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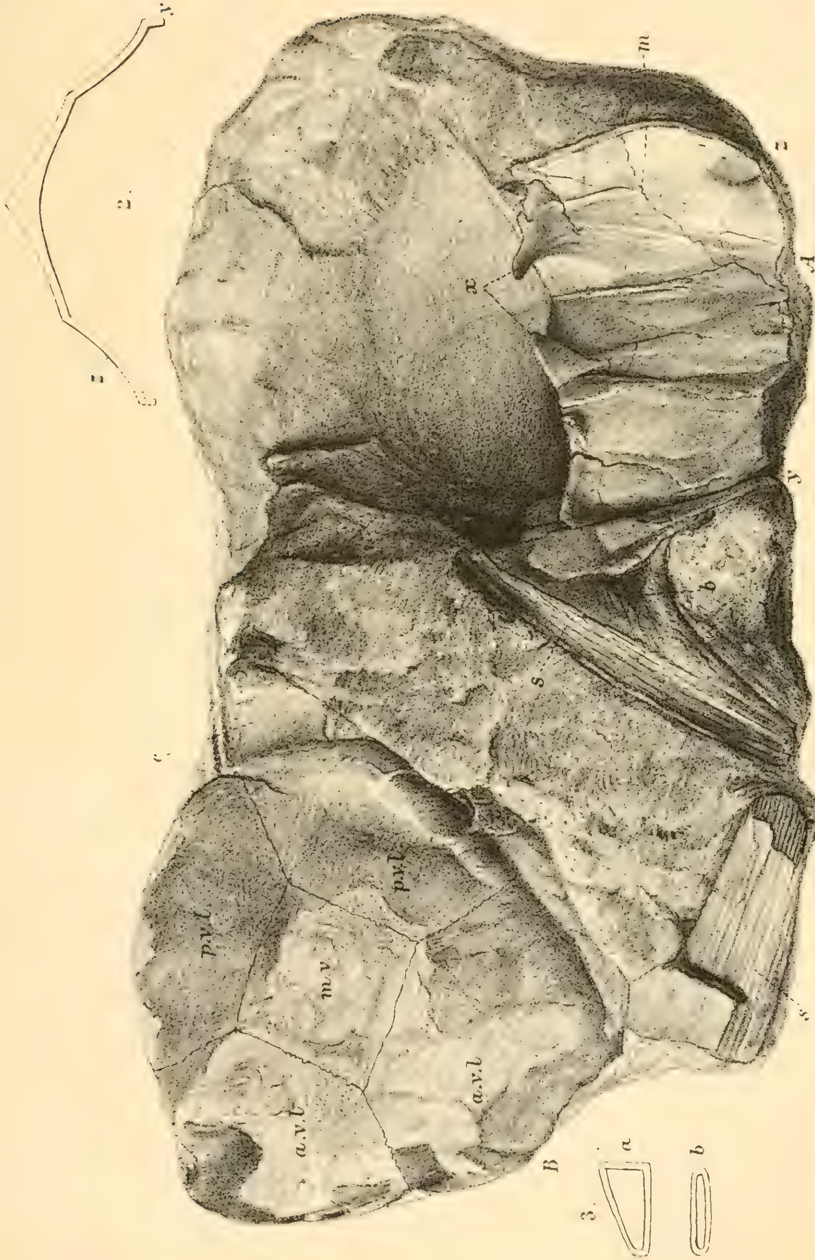
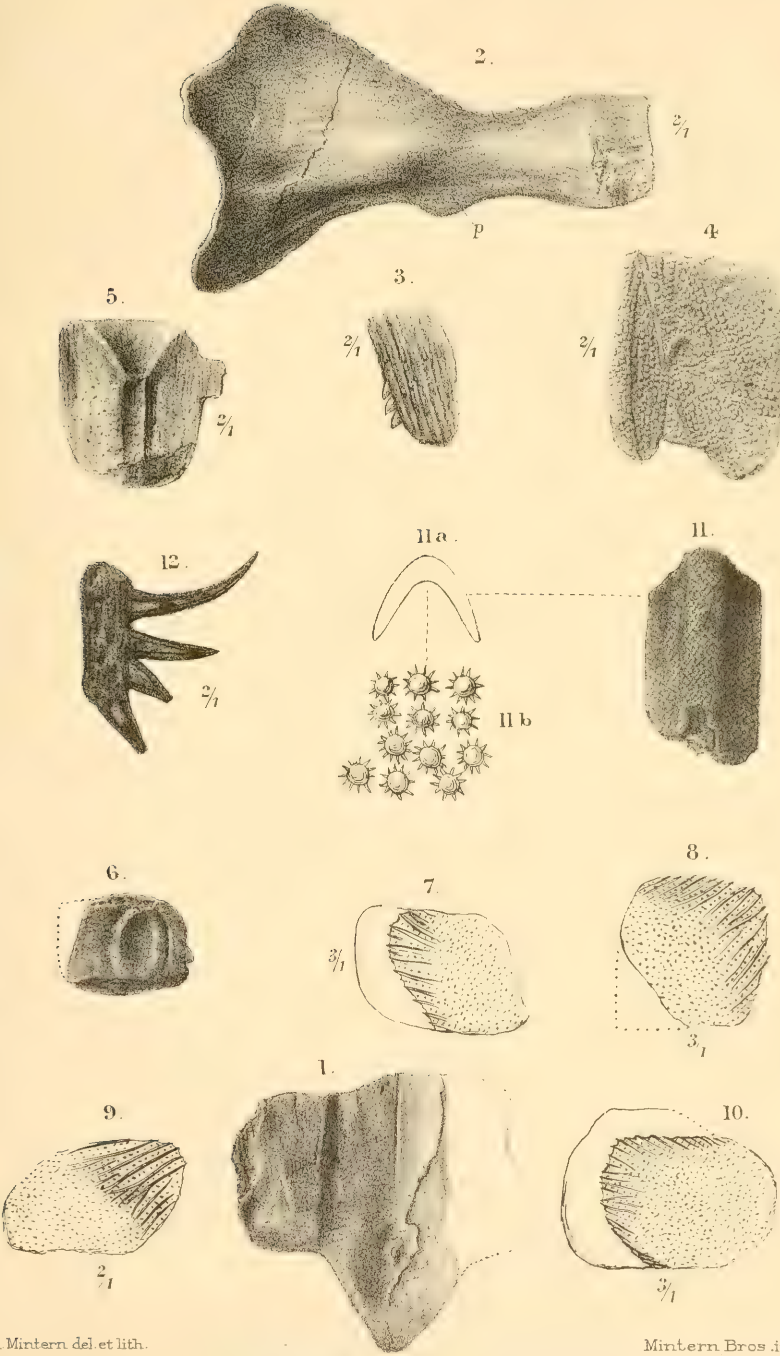


SPITZBERGEN DEVONIAN FISHES.
Acanthaspis decipiens.

R. Mintern del. et lith.

Mintern Bros. imp.



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SPITZBERGEN DEVONIAN FISHES.

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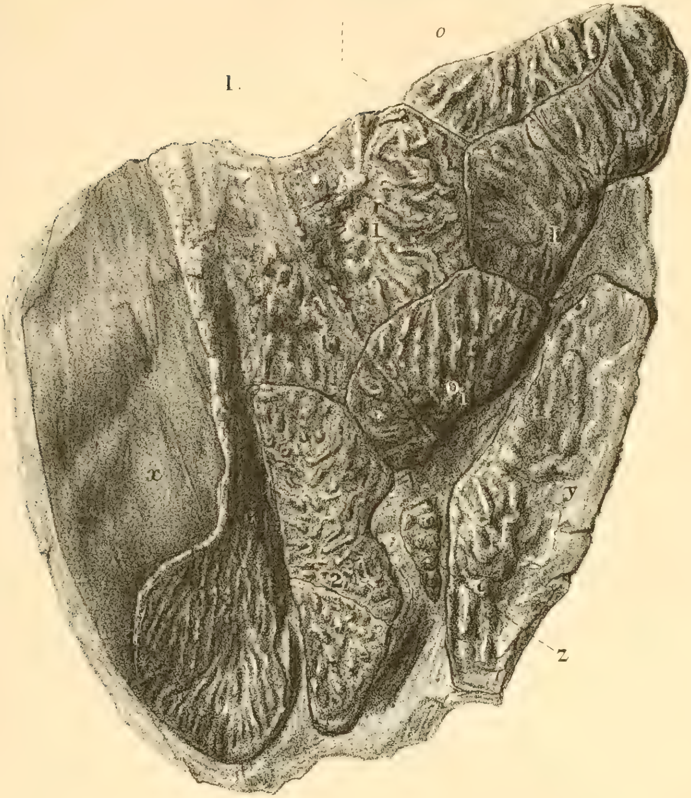

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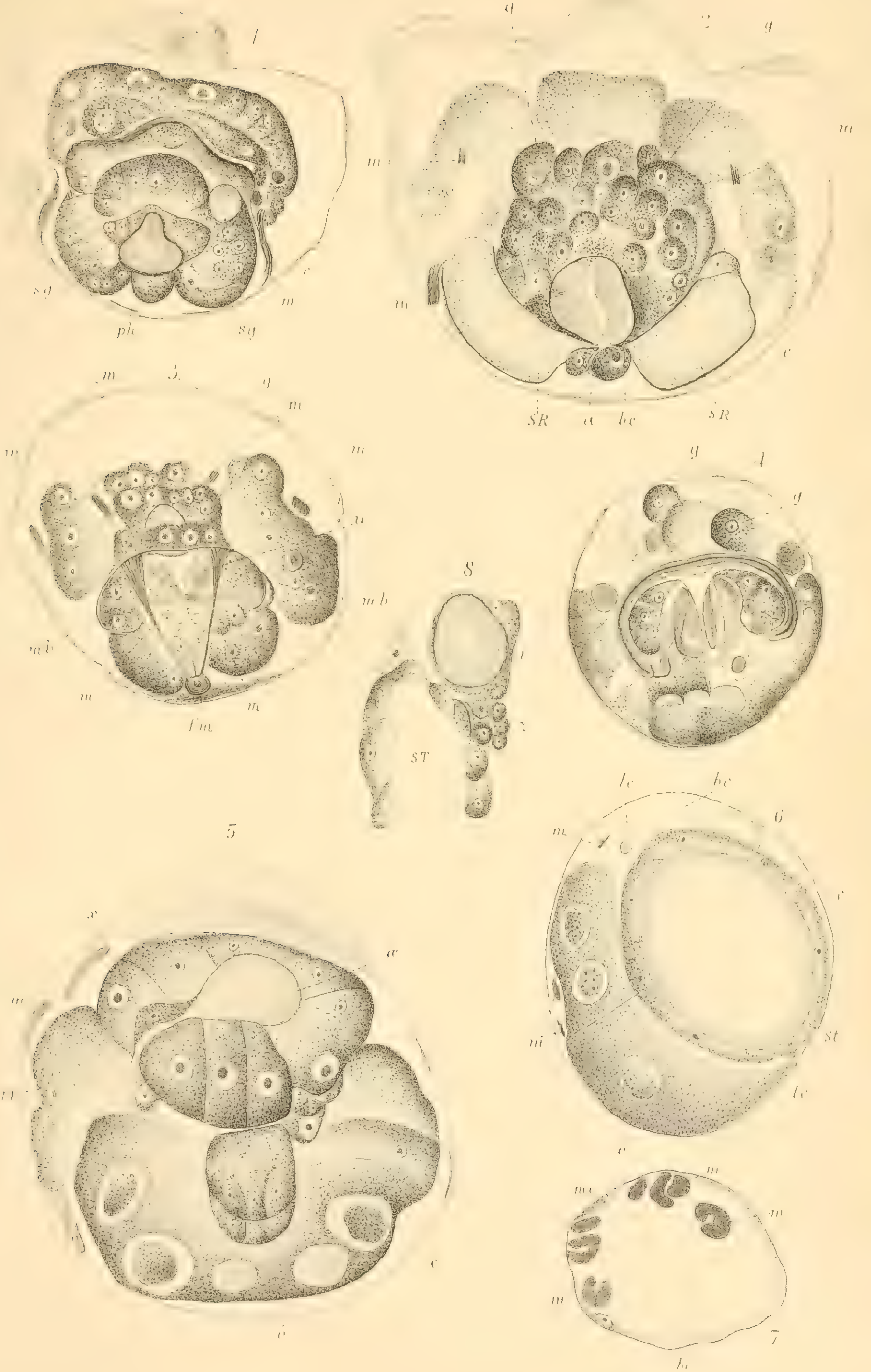
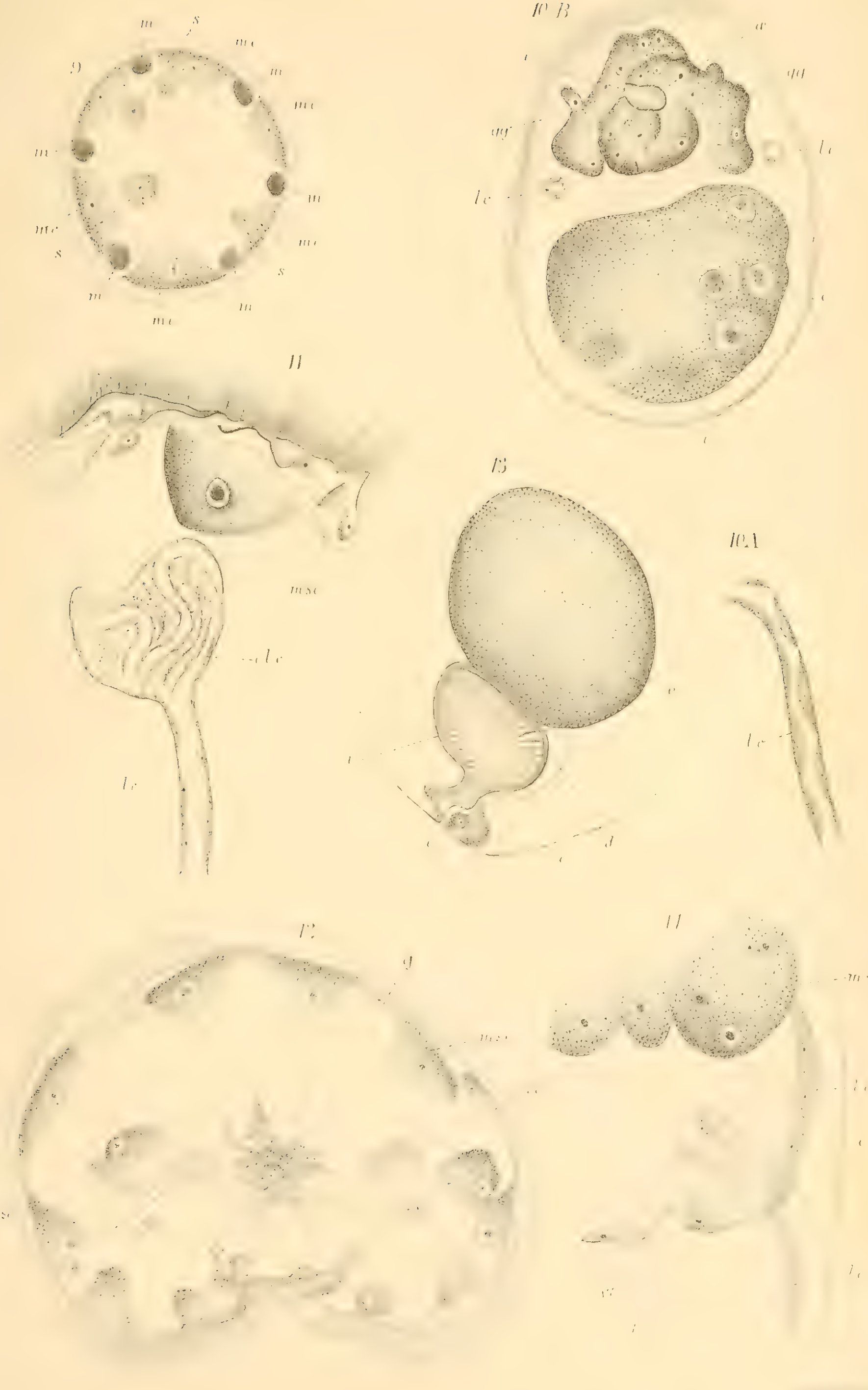
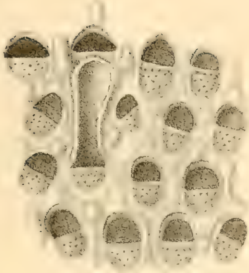
R. Mintern del. et lith.
Mintern Bros. imp

SPITZBERGEN DEVONIAN FISHES.
Asteroplax scabra.







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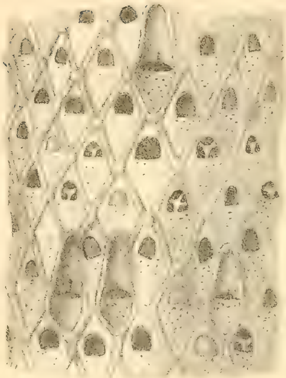

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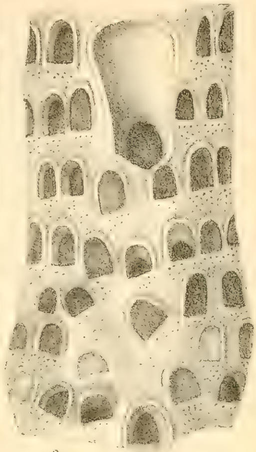

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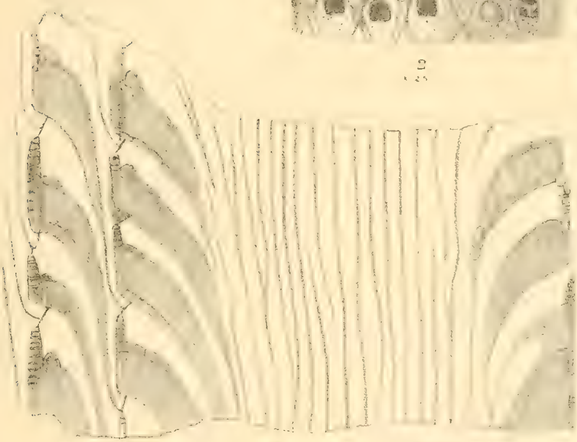

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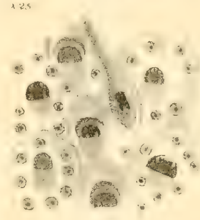

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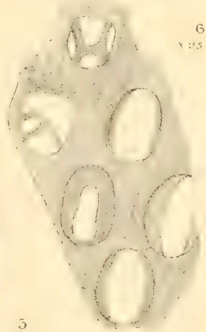

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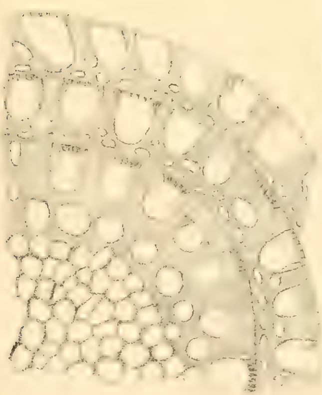

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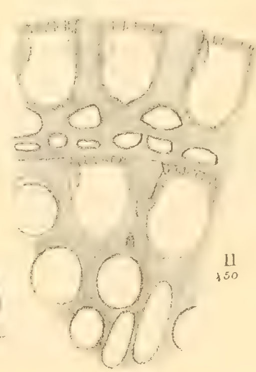

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A. W. Waters, del. R. Mintern lith.

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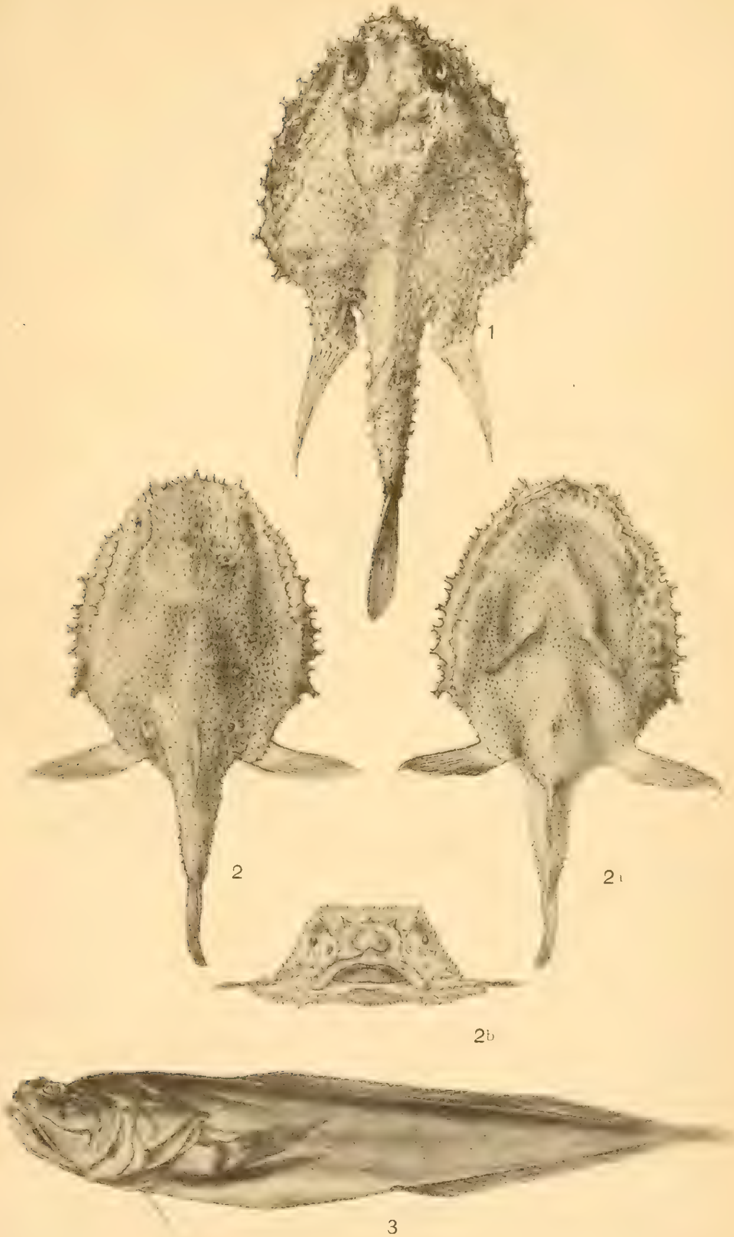

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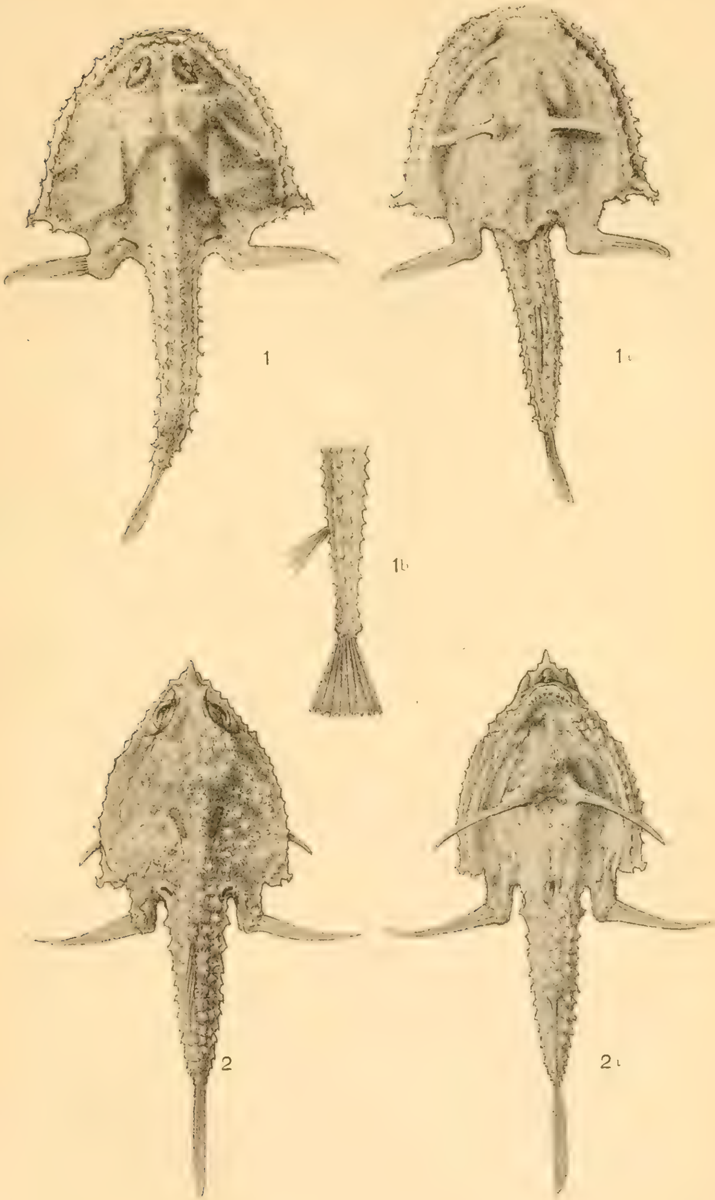
INDIAN DEEP-SEA FISHES.



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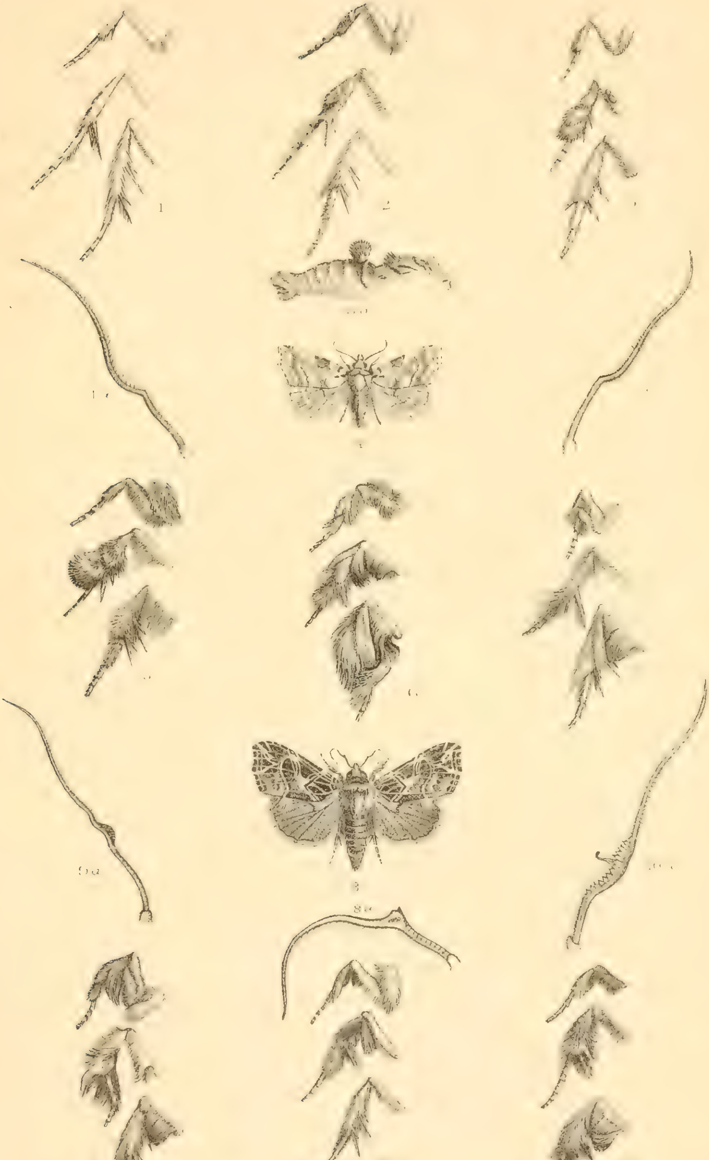

F. W. Frohawk del. et lith.

West, Newman imp.

Genera of Callopistriidæ.

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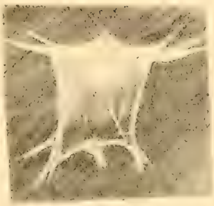

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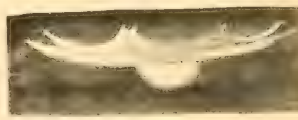

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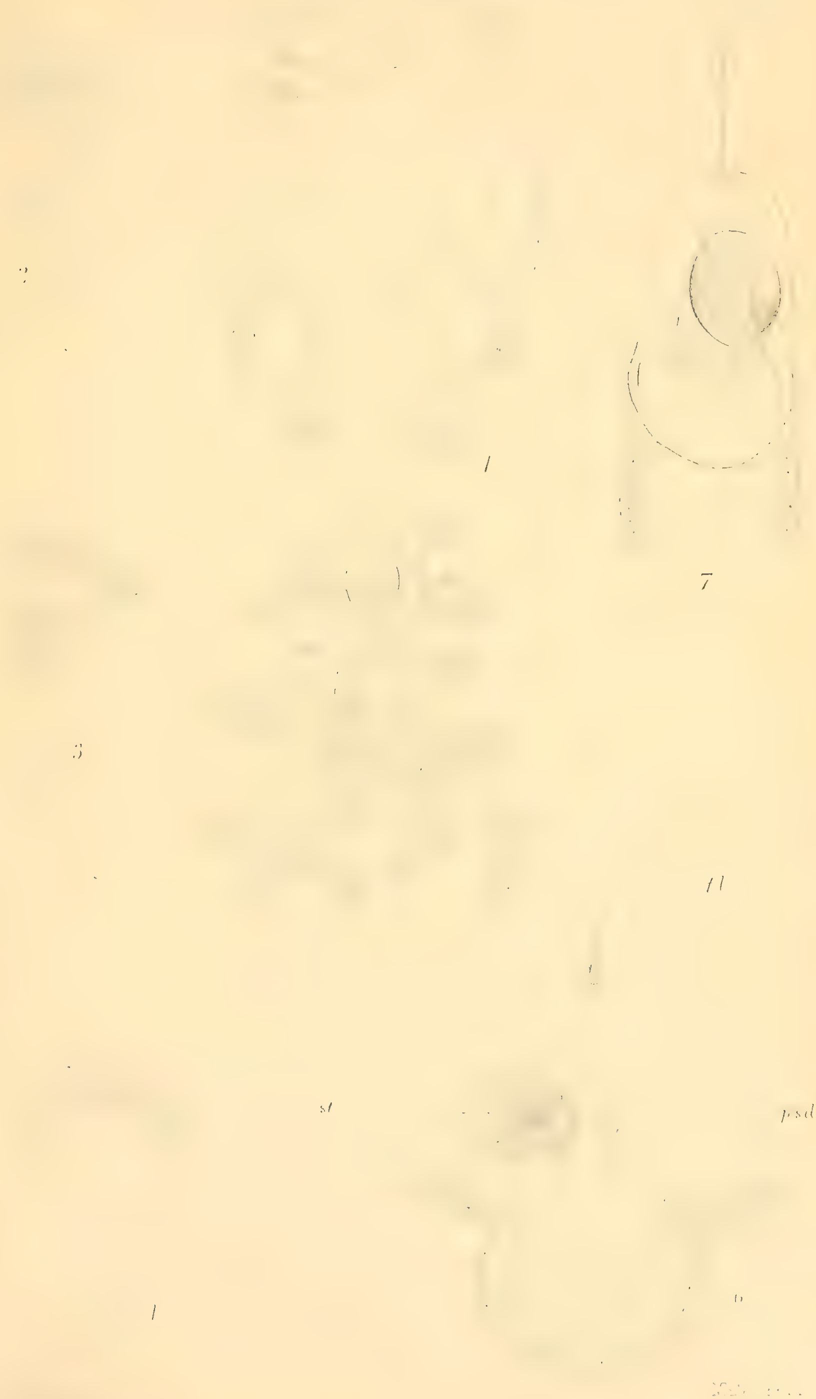

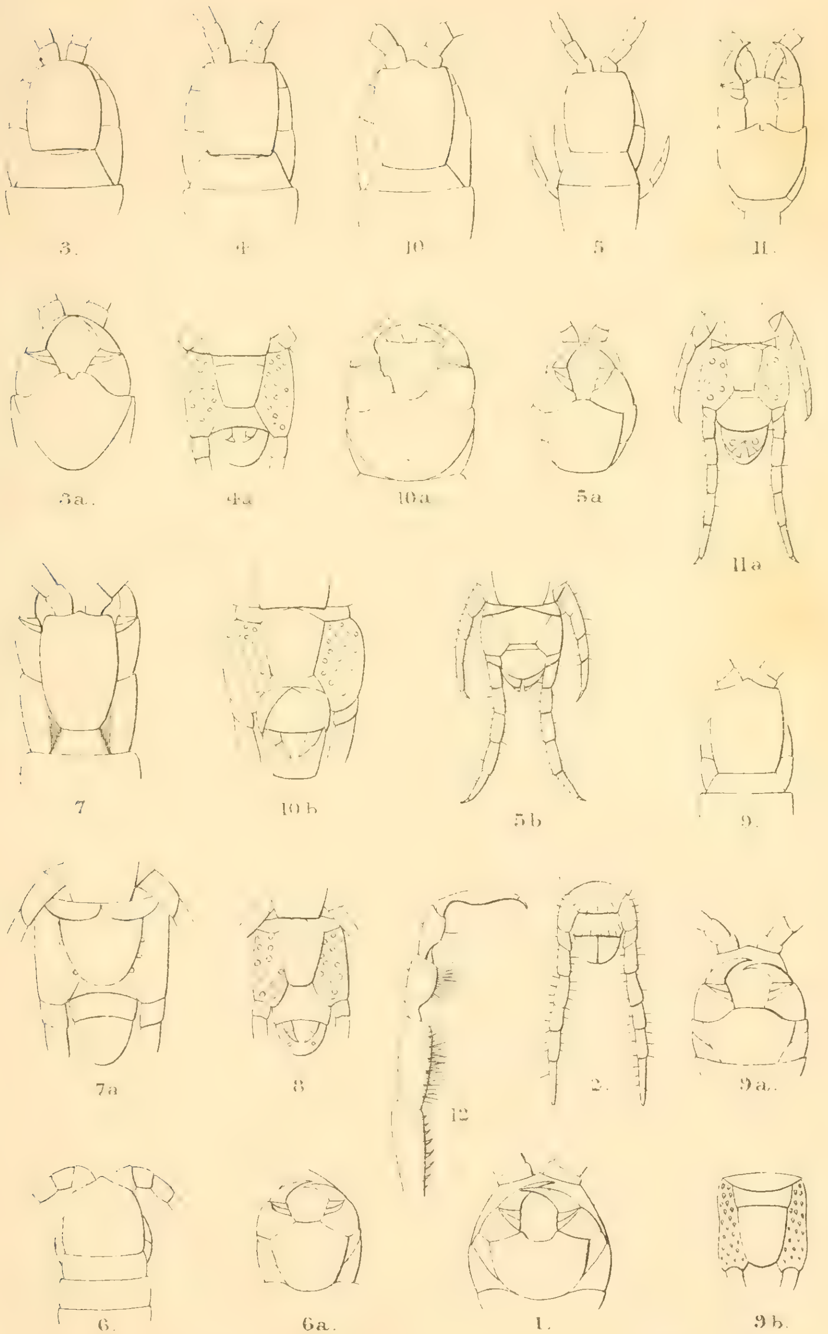

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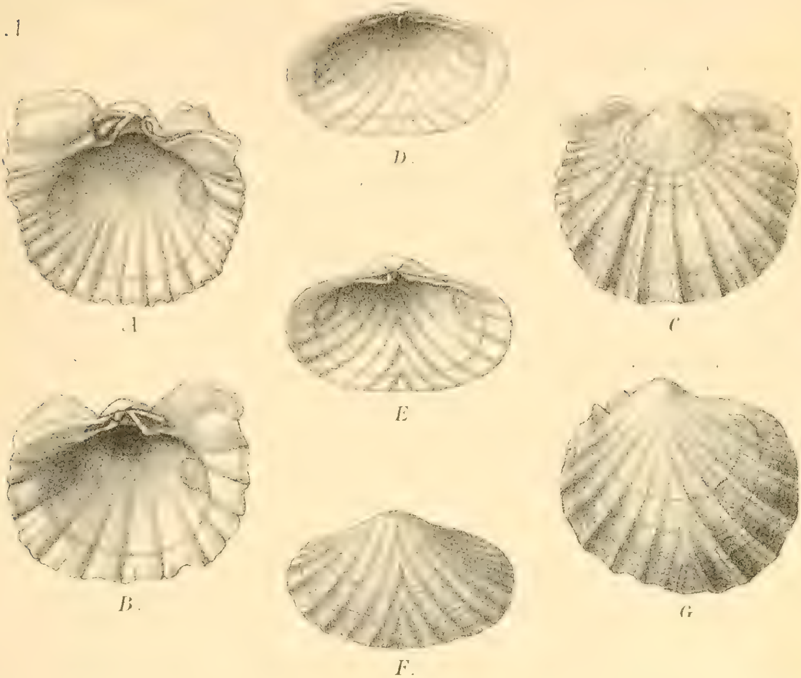

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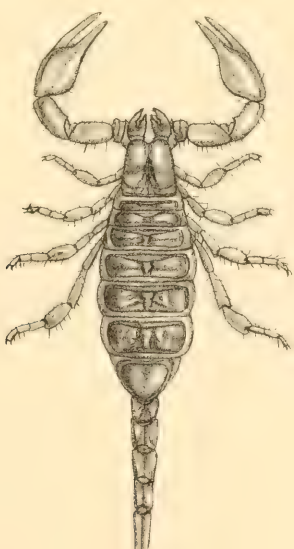

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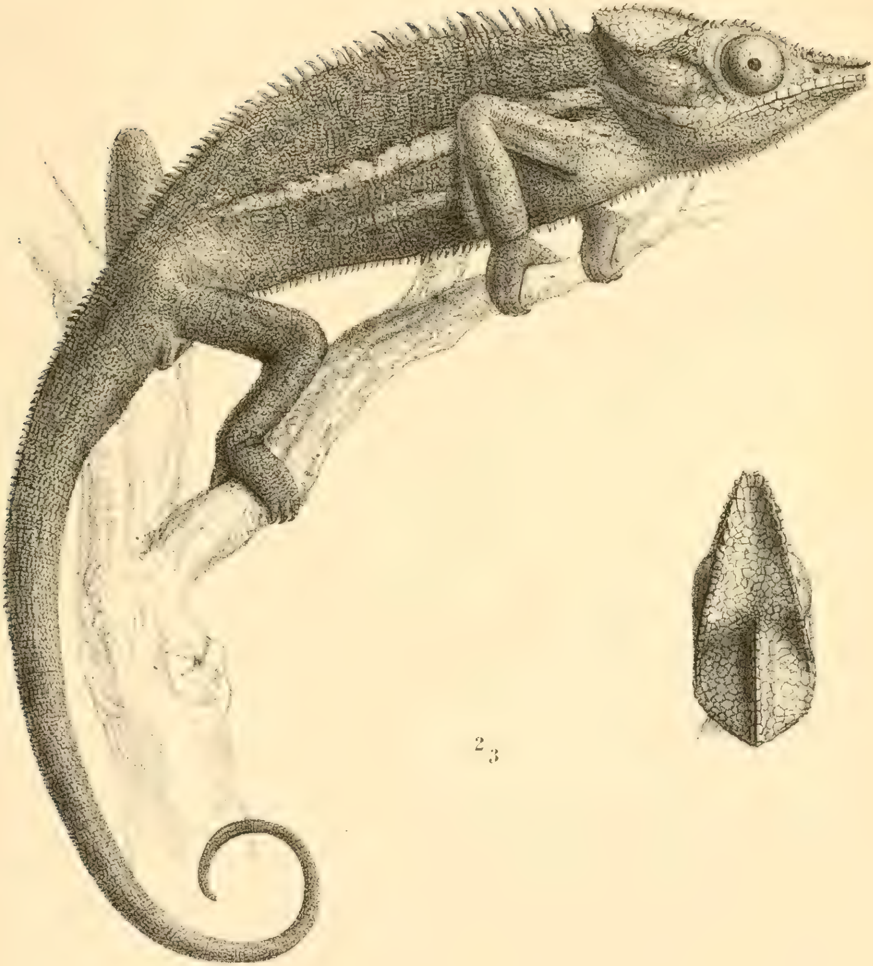

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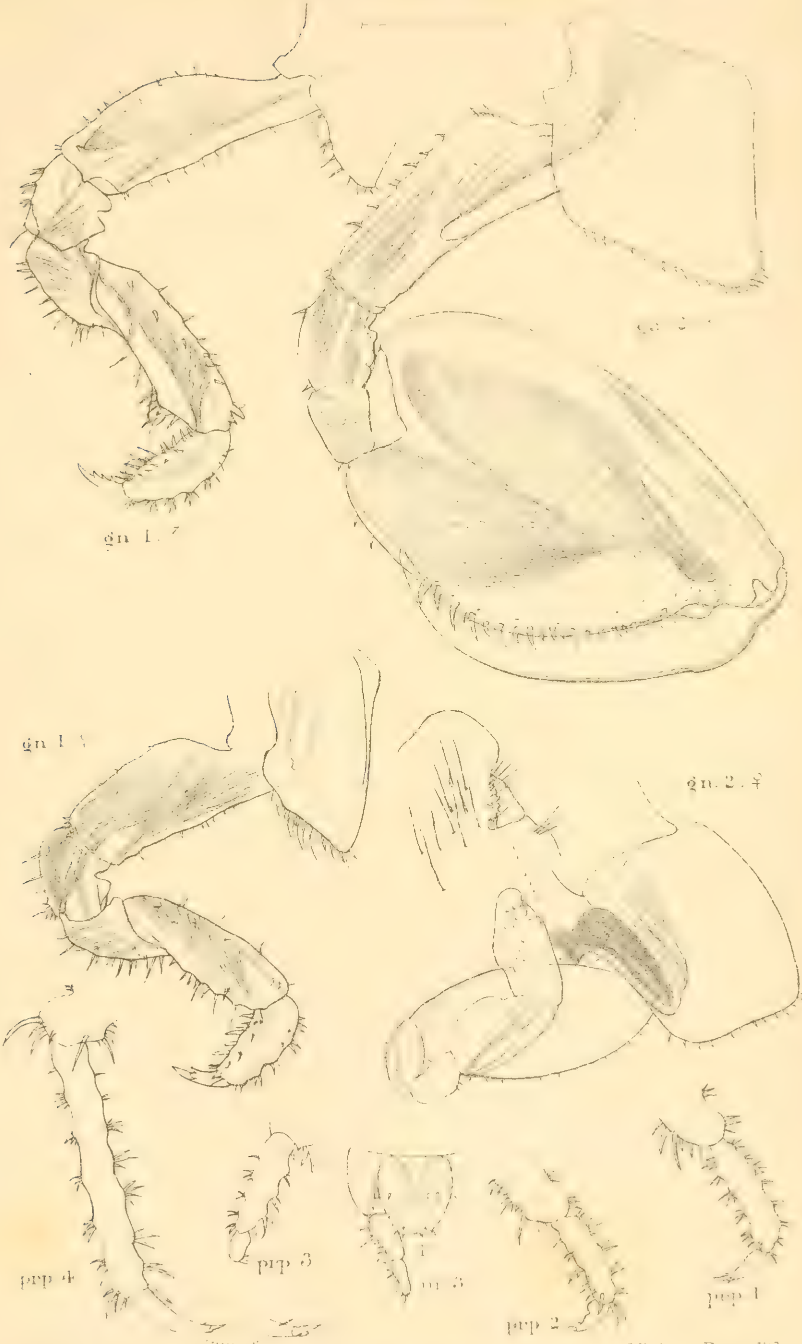

T R R. Stebbing del.

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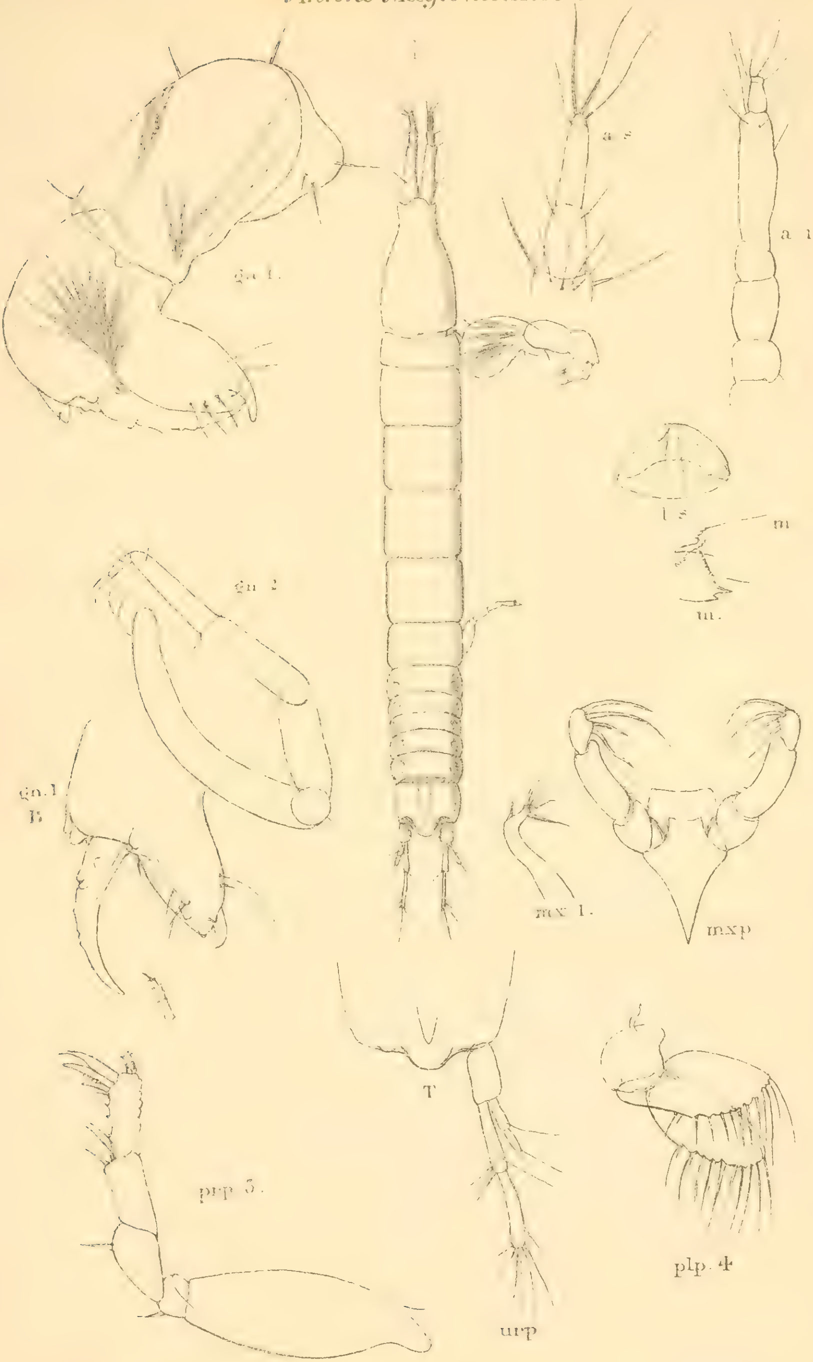

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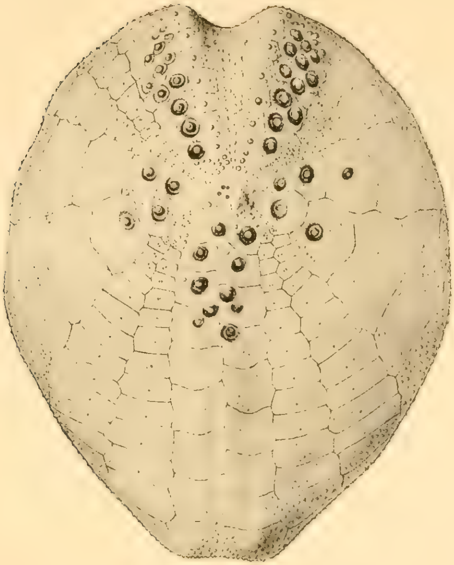

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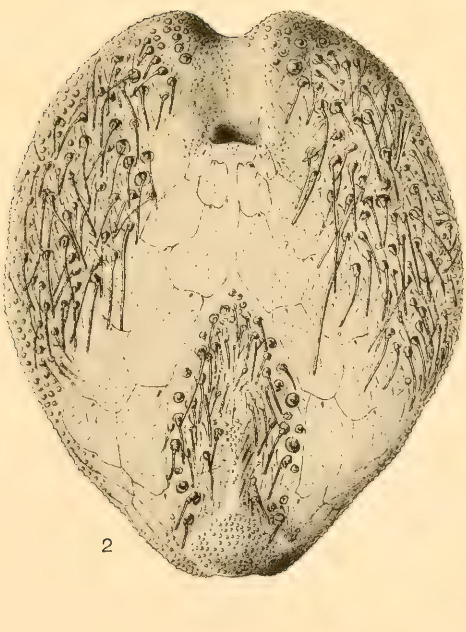

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B.L. DOS, DEL.

HOMOLAMPAS GLAUCA, W-M & A